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THESIS

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AN ANALYSIS OF THE REASONS WHY NONFERROUS
FOUNDRY SUBCONTRACTORS REFUSE TO
PARTICIPATE IN DOD BUSINESS

by

Jon Arthur Schaubert

June 1988

Thesis Advisor:

D.V. Lamm

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An Analysis of the Reasons Why Nonferrous Foundry
Subcontractors Refuse to Participate
in DOD Business

by

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
June 1988

ABSTRACT

This study attempted to identify the extent to which nonferrous foundry subcontractors have taken the position of refusing to participate in Department of Defense business and the principal reasons for this refusal. A survey questionnaire was sent to 1,326 domestic nonferrous foundries to obtain data on their attitudes concerning participation in DOD business. An analysis of subcontractor responses indicates that approximately 20% of the surveyed firms refuse, or intend to refuse, to participate in DOD business. The principal reasons for this refusal include inflexible Government procurement methods/policies, burdensome paperwork requirements and more attractive commercial sales to non-DOD prime contractors. The study analyzes each of these reasons as well as 20 additional problem areas. The differences between foundry subcontractors that intend to get out of DOD business and those subcontractors who are already out and intend to stay out are examined.

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I. INTRODUCTION

Concerns over a perceived decline in the Defense Industrial Base (DIB) have resulted in Congressional Hearings and numerous studies focusing on the extent of the apparent decline, the various reasons for it, and its effect on defense industrial mobilization and surge capabilities. Hearings and research conducted on the DIB strongly suggest that any problems associated with a shrinking, less competitive, less productive industrial base are particularly acute at its lower tier subcontractor levels. Among many hypothesized reasons for a shrinking subcontractor base is the suggestion that a growing number of capable subcontractors are becoming unwilling to accept Department of Defense (DOD) business.

This study analyzes one lower tier industry in the DIB: the foundry industry. The research was conducted in order to determine if foundries are unwilling to become involved with DOD business. The foundry industry is critical to both the national economy and the DOD. It is often cited by Government policymakers and academic researchers as an example of how our apparently shrinking industrial base is creating high cost, long leadtime, lower quality components for use in today's complex weapon systems. Worse, the domestic foundry industry is used as an example to

illustrate the negative consequences of ineffective Government regulatory, tax and profit policies, lack of sufficient industry capital investment and subsidized foreign competition.

This study focuses its research efforts on foundry industry subcontractors who refuse, or intend to refuse, to participate in DOD business. It attempts to analyze the reasons why those foundries do not participate in DOD business and determine their procurement policy implications.

A. RESEARCH OBJECTIVE

The research objective of this study is to conduct an analysis of lower tier foundry subcontractors who refuse to participate in DOD business in order to determine the magnitude of the problem and the most significant reasons for it.

B. RESEARCH QUESTION

Given the preceding research objective, the primary research question in this study was, "To what extent do foundry subcontractors refuse to participate in DOD business?"

In addition to the primary research question, the following subsidiary research questions were formulated:

1. What are the key reasons for refusing DOD business?
2. Can any foundry industry trends be identified?

3. What procurement reforms would have the greatest impact on foundry willingness to accept DOD business?
4. What are the implications for procurement policy?

C. RESEARCH HYPOTHESIS

The initial research hypothesis was: "Increasing numbers of foundries are refusing to participate in DOD business either directly as prime contractors or indirectly as subcontractors. There are identifiable reasons for this non-participation in DOD business."

D. SCOPE, LIMITATIONS AND ASSUMPTIONS

This study focuses on domestic foundry subcontractors that currently refuse, or intend to refuse, to participate in DOD business. Because many of these businesses could have been DOD subcontractors in the past, but are not now, no study limiting distinction will be based on known commercial or defense sales. The research objective of studying only lower tier foundry subcontractors in the DIB presented a crucial definitional issue for the researcher. This definitional issue involved the classification of a firm as a subcontractor. Four categories were developed to classify contractors in general:

1. a prime contractor who has never been a subcontractor,
2. a prime contractor who sometimes performs as a subcontractor,
3. a subcontractor who has never performed as a prime contractor, and,

4. subcontractors who sometimes perform as prime contractors.

This study identified and analyzed the last two categories of contractors in the foundry industry. The researcher used two additional criteria to further refine the definition of a foundry industry subcontractor; first that 50% or more of its total annual sales be directly applicable to subcontract performance; and second, that the foundry identify itself as performing primarily as a subcontractor within its industry. While the focus of this study was on the "pure subcontractors" in category three; subcontractors in category four, "primarily a subcontractor," were also studied due to the assumption that these subcontractors would have the same reasons for not participating in DOD business that the "pure subcontractors" had and therefore are a valid part of this research study.

The scope of this research effort was reduced further by studying only domestic nonferrous foundries. This was done because of the critical importance of nonferrous castings to the DOD and because nonferrous castings tend to represent the more complex, state-of-the-art type castings increasingly used in weapon systems. By focusing exclusively on nonferrous foundries, the researcher was able to survey a much larger total percentage of the actual foundry population studied.

The researcher faced several significant research limitations in attempting this study. The primary research

objective was to analyze the reasons why foundry subcontractors refuse or intend to refuse DOD business. Identifying and locating sufficient numbers of firms which fell into this category became a significant limitation. There are approximately 4000 domestic foundries. Out of this domestic foundry base less than 50% are involved with nonferrous castings. In general, foundries that refuse to do business with the Government are extremely reluctant to identify themselves as such. Out of choice, these firms typically have very little visibility with the Government. Therefore they are not on bidders lists, do not respond to Government solicitations and are not found in various Government maintained databases. Foundries intending to refuse future DOD business generally do not advertise their intentions and lose their visibility to the Government for many of these same reasons. The foundry industry is often characterized by its own members as secretive and somewhat paranoid-particular of the Government. It overwhelming consists of small businesses operating in the proverbial "bicycle shop" down the street. Numerous references to the "art" and "black magic" of casting were made to this researcher. These comments are repeated here to underscore the difficulties in obtaining data from some of these firms. Due to the difficulties in identifying foundries (of any kind) possessing the attitude of refusing to participate in DOD business, the researcher decided to survey, on a

strictly confidential basis, the largest number of foundries possible within time and resource limitations. Given the demographics of the foundry industry and the critical widespread use of its cast products in the DOD, nonferrous foundries were specifically targeted for study using a confidential "chunk" survey. The survey methodology is explained in Chapter III.

Another significant limitation in this study was the inability of this researcher to randomly sample the foundry industry for these attitudes and therefore be able to draw probabilistic conclusions from the data obtained. A survey methodology using random sampling was not used by the researcher due to initial difficulties in obtaining accurate, unbiased foundry industry data at the individual firm level. Foundry industry data are inconsistently collected by both foundry trade associations and the Government. By merging various nonferrous foundry databases, the researcher produced a usable survey mailing list but also introduced significant bias in the process. This was due to the nature and source of some of the databases used.

A final limitation was the lack of current literature concerning lower tier subcontractors in the DIB. Though numerous studies cited acute problems at these lower tiers, no research literature could be found with current objective data on the health, capacity, productivity and numbers of

subcontractors in the DIB. Specific subcontractor data on the foundry industry does not exist.

A number of significant assumptions were made at the outset of this research effort. The most important assumption was that a significant number of foundries actually do refuse, or intend to refuse, DOD business and that a sufficient number of these types of firms could be identified for study. Another significant assumption was that the vast majority of the domestic foundry base consisted of small businesses performing either exclusively or primarily subcontract work. Finally, it was assumed that by using a survey methodology, the most significant reasons for not participating in DOD business could be identified and analyzed.

E. RESEARCH METHODOLOGY

The research methodology was threefold. First; a comprehensive literature review was conducted on the DIB and the foundry industry. This review focused on concerns over the apparent erosion-particularity at the lower tier subcontractor level-of both the DIB and the domestic foundry base. Second; 1,326 nonferrous foundries were identified through an extensive search of Government and trade association databases and subsequently surveyed on their attitudes concerning DOD business. Third; the researcher toured a major nonferrous foundry in the Los Angeles area and conducted informal, confidential interviews with foundry

representatives from the area to help clarify, interpret and analyze the preliminary data obtained from the survey. The data collected from the survey and interviews are presented on a non-attribution basis in Chapter IV.

F. ORGANIZATION OF THE STUDY

Chapter II presents the reader with background information on DIB policy, problems and issues and provides an overview of the domestic foundry industry. Chapter III describes the background and development of the survey questionnaire. Chapter IV presents an in-depth analysis of the data obtained from the survey and clarifying insights from the interviews. Chapter V presents principal findings, conclusions and recommendations. Recommendations for future research are also suggested.

II. BACKGROUND AND LITERATURE REVIEW

A. CHAPTER OVERVIEW

This chapter begins with a brief overview of the Defense Industrial Base (DIB) and a description of its lower tier subcontractors and suppliers. Following this overview, the researcher explores the problems and issues confronting these lower tier subcontractors and presents a brief analysis of the reasons why contractors leave the defense marketplace and refuse to do business with the Government. The chapter concludes with a foundry industry overview, its importance to the DIB and its relationship to this study.

B. THE DEFENSE INDUSTRIAL BASE

1. Introduction and Background

This overview does not attempt to comprehensively revisit the large number of studies, findings and conclusions on the entire DIB. Rather it attempts to focus on the supporting structure of the DIB-the lower tier subcontractors and suppliers, the problems and issues confronting them, and their relationships with the Government and prime contractors. Research in this area suggests that industrial bottleneck and production constraint problems in a shrinking, non-competitive, non-productive DIB are particularly acute at these lower tier subcontractor levels. [Ref. 1:pp. 2-8] Numerous reasons

are hypothesized in the literature for an eroding subcontractors' support base. The researcher attempts to explore and analyze the most significant ones.

The DIB is "composed of prime contractors and supporting tiers of subcontractors, with the plant and equipment and skilled workers, necessary to develop and produce the hardware required to fulfill the nation's defense programs." [Ref. 2:p. 2-1] Most of the literature on DIB deals with problems associated with the upper tiers of the base and its major prime contractors such as Northrup, Rockwell and Sperry. Very little of the literature actually analyzes the lower tier subcontractors and suppliers which are far more numerous and essential to the success of the prime contractors. Ironically, almost all of the significant studies done in the last ten years have concluded that the problems and issues confronting the prime contractors are also felt in a more magnified way by their lower tier subcontractors. [Ref. 3:p. 9] The literature also concludes that these problems and issues are forcing lower tier subcontractors and suppliers out of the Department of Defense (DOD) marketplace and are creating an environment where capable contractors refuse to do business with the Government. [Ref. 1:pp. 2-6]

Concerns over a shrinking, non-competitive and increasingly less productive DIB have prompted Congressional Hearings and numerous Government and industry studies.

These studies have tried to determine the extent of the apparent decline in the DIB, the various reasons for it, and its effects on national security. These studies have consistently identified DIB problems including diminishing capacity, shortages in critical raw materials and components, rapid cost growth, lengthening leadtimes, decreasing productivity, increasing offshore procurement/production and domestic industrial bottlenecks. [Ref. 4:pp. 3-7]

These problems and a growing national perception, increasingly substantiated by empirical research data and various statistical comparisons, suggest that America's Industrial Base could be sliding into a second class status. According to an unpublished OSD staff study by the Defense Industrial Base Assessment Office entitled, "Strategy for Bolstering Industrial Competitiveness," numerous basic industries have declined and this erosion could leave the United States without the industrial capabilities that are critical to national security. [Ref. 5:p. I-1] This study was directed by Dr. Robert B. Costello, Under Secretary for Defense (Acquisition), (USD(A)), and focused not only on the ability of America's DIB to actually produce and deliver affordable, technologically superior weapon systems, but also on our ability to use our industrial capabilities to maintain a credible deterrence and our diminishing

leadership position in an increasingly competitive international marketplace.

2. Policy and Programs

Historically, the United States Government has relied on the private sector to provide the "weapons of war." One of the fundamental elements of our current national security strategy and defense policy is "...the maintenance of a broad, technologically superior (industrial) mobilization base...." [Ref. 6:p. 21]

Success in developing and producing weapon systems relies heavily on this national goal of maintaining superior technological and industrial capabilities of the DIB. [Ref. 2:p. 2-1] Congress has long recognized the national importance of our DIB from a national security standpoint and has enacted legislation in 1950 (the Defense Production Act), and in 1973 (the Defense Industrial Reserve Act), to make the Department of Defense responsible for ensuring that "...the existence of a viable industrial base to supply military needs in time of national emergency...." [Ref. 7:p. 124] Presidential Executive Order 11490 and Defense Mobilization Order VII assigned responsibility to the Department of Defense along with industry and other Government agencies for conducting industrial preparedness planning. The Department of Defense has issued a series of industrial base policy directives and instructions to

implement the legislative and executive requirements. The major DOD instructions include: [Ref. 2:p. 2-20]

- DODD 4005.1: "DOD Industrial Preparedness Production Planning"
- DODI 4005.3: "Industrial Preparedness Planning"
- DODD 4005.16: "Diminishing Manufacturing Sources and Material Shortages."

The Department of Defense is a logical choice for responsibility and oversight of industrial preparedness planning. The Department of Defense's mission is to provide for the common defense. Deterrence of aggression is at the foundation of its common defense mission and the deterrent power of the U.S. military rests on the inventory of sophisticated equipment and the human resources to manage and operate it. These resources are drawn from and replenished from our industrial economy. [Ref. 5:p. II-11] Our strong industrial economy facilitates a credible common defense based on deterrence.

Given the recognized need for a strong, productive industrial capability and a national policy to maintain it, a number of DOD initiated programs have been developed in the last eight years to address known deficiencies in the DIB. The Technical Modernization (TECHMOD) and Industrial Modernization Incentives Program (IMIP) are two examples of this effort to address DIB capability and productivity problems. Both programs represent formal agreements between industry and DOD on financial incentives for modernizing and

improving plant productivity and capabilities. The incentive structure of these programs is built around shared savings based on increased productivity achieved through capital investment. These programs have recognized the need to incentivize subcontractors and vendors as well as the primes and the Air Force is currently spending \$200 million on Aerospace Industry subcontractors through these programs. [Ref. 8:p. 1] Early Air Force successes with both TECHMOD and IMIP spawned the Industrial Technology Modernization (ITM) program for subcontractors. ITM essentially provides the same types of modernization incentives for subcontractors with this program being managed by the prime contractors. [Ref. 9:p. 26] Another program designed to address DIB shortcomings is the Manufacturing Technology Program (MANTECH). The objective of MANTECH is to "assure that advanced manufacturing processes and equipment are available to defense contractors to enable them to significantly improve their productivity and responsiveness as elements of the defense industrial base." [Ref. 10:p. 201] The purpose of this program is to reduce acquisition costs and production leadtimes by funding advanced manufacturing technology and equipment in situations where the private sector is unable or unwilling to do so. Differing from the TECHMOD and IMIP programs, MANTECH is totally funded by Government sources. MANTECH monies are usually invested in high risk-high payoff state-of-the art

technologies and materials. [Ref. 11:p. 32] Carbon composite and metal matrix materials technologies are two current areas where MANTECH monies are being invested. Each of these programs has met with varying degrees of success at improving DIB deficiencies. It is important to note that these programs have been primarily directed towards the major prime contractors with relatively little emphasis on the supporting lower tier subcontractors. Additionally, the prime contractors in these programs are often reluctant to flow down these development/productivity incentives to their subcontractors. Finally these programs appear to suffer from budgeting constraints and limited/cyclical service sponsor interest.

3. Composition and Interrelationships

The DIB consists of tens of thousands of business firms and Government facilities that produce the weapons and services used by the Department of Defense. These firms that collectively make up the DIB include large corporations as well as small privately owned family businesses. Many of these firms manufacture/provide both defense and non-defense products. The larger firms typically act as weapon systems integrators and assemblers of equipment, such as aircraft and missiles, while the smaller firms typically design and manufacture piece parts, components and subassemblies which are used by the larger prime contractors. [Ref. 4:p. 1]

The DIB can be thought of as a "pyramid" built from the base up on "procurement tiers." These tiers are composed of the various large and small businesses. Firms that directly contract with the Department of Defense are known as prime contractors or "primes." These primes represent the top of this multi-layered pyramid or its first tier. Below the first tier level primes are the thousands of second and third tier level firms who generally do not directly deal or contract with the Department of Defense. These second and third tier firms are the "subcontractors" and "parts suppliers" which supply the piece parts, components and subassemblies used by the primes in the first procurement tier.

There are approximately 25,000 to 30,000 prime contractors which supply the Department of Defense with weapon systems and major components. Supporting these prime contractors are approximately 50,000 subcontractors and parts suppliers in the lower tiers. [Ref. 4:p. 1] Some of the literature suggests that the base may actually contain as many as 60,000 prime contractors and hundreds of thousands of subcontractors. [Ref. 12:p. 75] Even though these estimates appear to suggest that a large industrial base exists at the prime contractor level they are misleading. The most current data obtainable by the researcher (FY86) indicates that the top 200 prime contractors for the Department of Defense accounted for

75.1% of all contract award dollars for contracts over the small purchase threshold of \$25,000. [Ref. 13:p. 21]

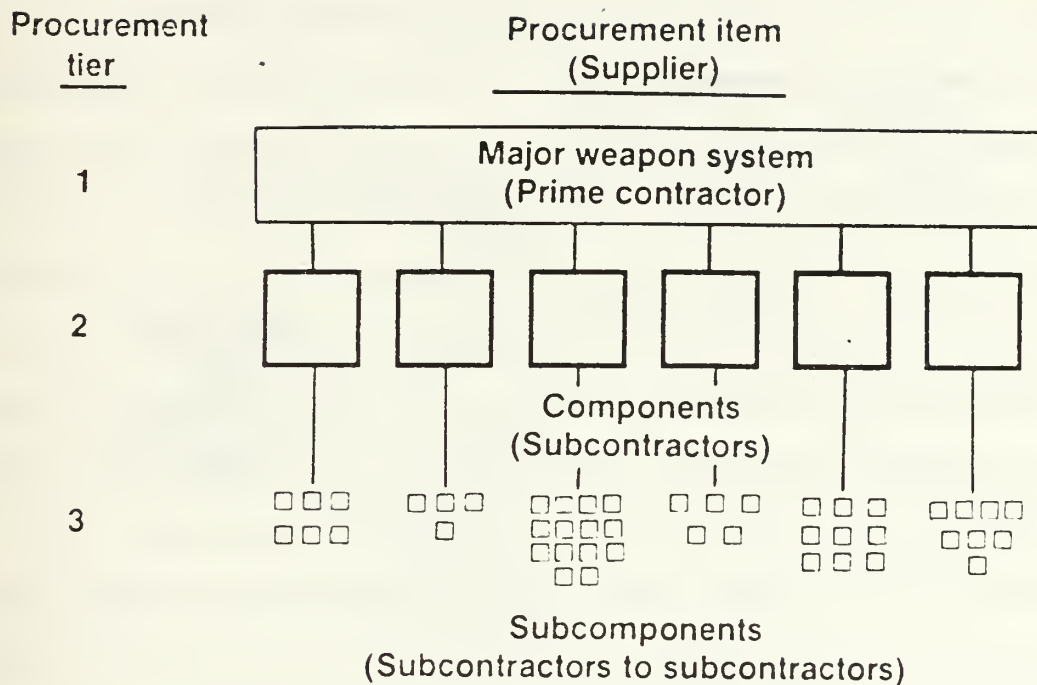
Estimating the actual size of this base (particularly below the prime contractor level) is extremely difficult because of its constantly fluctuating state and the complex interrelationships between the firms within it. In fact, no data have been collected on the lower tier (and far more numerous) subcontractors by the Department of Defense since 1963. [Ref. 7:p. 129] Firms constantly enter and exit the base at each tier level (though to a much lessor degree at the prime contractor level) and change the amount and proportion of the resources they devote to their defense products and services. These DOD products and services can represent all or only part of a firm's business base and can be produced with or without using Government resources. The following examples illustrate some of the different mixes of resources used within the DIB: there are Government owned and Government operated facilities, Government owned contractor operated facilities, contractor owned facilities operating with Government owned equipment and wholly contractor owned facilities. [Ref. 14:p. 11]

Finally, determining whether a firm is a prime contractor or a subcontractor is complex and difficult. It can depend on the contractual relationship between a business and the Government while producing a particular weapon system. A firm may identify itself as a prime

contractor for one particular weapon system and as a subcontractor for others. In other words, many prime contractors for one major weapon system are often subcontractors on others. [Ref. 15:p. 2] In "An Analysis of Reasons Companies Refuse to Participate in Defense Business," Dr. David V. Lamm found that 62.8% of the companies responding to his survey considered themselves to be both a prime contractor and a subcontractor. [Ref. 16:p. 78] This complex, pyramidal structure of the DIB is illustrated in the following figures.

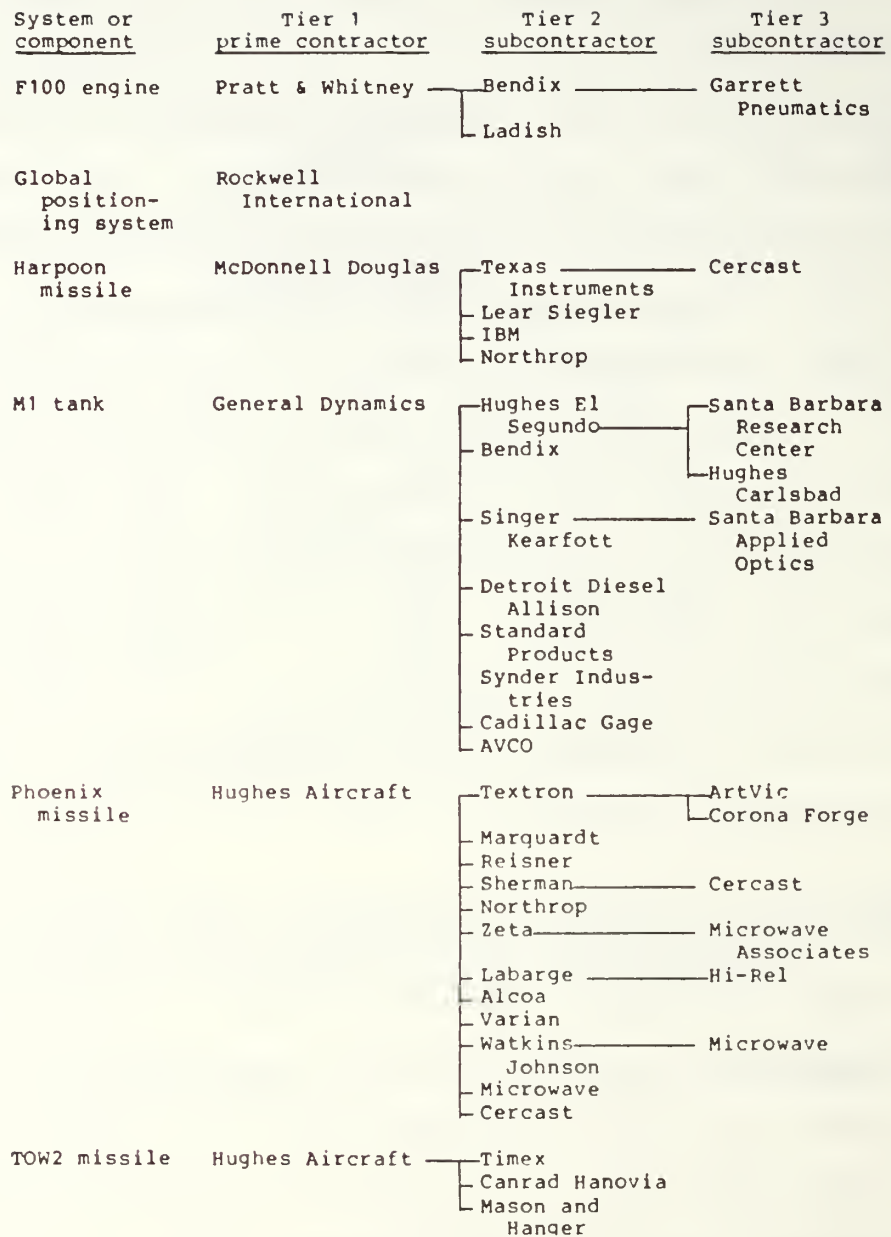
Figure 2-1 illustrates the multi-layered procurement tiers from the prime contractors down to the supporting base of sub-subcontractors and parts suppliers. Each tier is tied to the others in a production relationship where raw resources are converted into increasingly more complex products as they move "up" the pyramidal structure of the DIB.

Figure 2-2 illustrates the critical prime and subcontractors in each procurement tier for five major weapon systems studied by the General Accounting Office. There are many more supporting lower tier level subcontractors than are shown in Figure 2-2. Only those subcontractors involved with manufacturing critical components and vulnerable to potential production constraints are shown. Notice the interrelationships between the firms in each of the tiers and the dual roles some firms have such as



Source: GAO, "Assessing Production Capabilities and Constraints in the Defense Industrial Base," GAO/PEMD-85-3, April 4, 1985.

Figure 2-1 DIB STRUCTURE AND RELATIONSHIPS



Source: GAO, "Assessing Production Capabilities and Constraints in the Defense Industrial Base," GAO/PEMD-85-3, April 4, 1985.

Figure 2-2 CRITICAL PRIME/SUB CONTRACTORS FOR FIVE WEAPON SYSTEMS

Microwave Associates and Cercast. Also notice that traditional prime contractors such as Hughes and Northrup are acting as lower tier subcontractors to other prime contractors for these particular weapon systems.

The production relationships between each procurement tier of the DIB ultimately define the success of the relatively few prime contractors in producing state of the art, high quality, reasonably priced weapon systems for the DOD. It is the supporting lower tiers of the DIB which convert the vast majority of these raw resources into the basic products, components and subassemblies that the upper tier prime contractors integrate into weapon systems. Most of the literature reviewed suggests that if an industrial base problem exists, it is with these basic lower tiers that drive it. It is in the lower tiers where the greatest erosion of the DIB has occurred and it is the loss of these lower tier subcontractors and suppliers that create the longer leadtimes, production constraints and escalating prices that concern policymakers so much. The next section of this chapter explores and analyzes the forces affecting the lower tiers of the DIB.

C. THE SUBCONTRACTOR BASE

1 Introduction

The literature cites both direct and indirect constraints on the DIB's productive capacity and its ability to surge and mobilize. Relatively few production constraints

appear to exist at the prime contractor level. [Ref. 4:p. vi] This is not true for the lower tiers of the DIB. The literature suggests that it is really the lower tiers of the DIB which represent the bottlenecks and significant production constraints due to the "difficulties in obtaining necessary items from subcontractors, resulting at least in part from a shortage of smaller, lower-tier suppliers." [Ref. 4:p. 2] This chapter segment will explore the forces affecting these lower tier subcontractors and suppliers and analyzes how those forces are causing the lower tiers to shrink in size, inhibiting competition, creating longer leadtimes and causing price increases.

2. Problems and Issues

Materials and components procured from lower tier subcontractors and suppliers represent 50% to 80% of the Department of Defense's total procurement costs. [Ref. 5:p. V-7] The magnitude of these procurement costs with the lower tiers of the DIB make understanding the factors affecting those lower tiers critical. In his book, The Defense Industry, Dr. Jacques Gansler ponders the question of why the Congress and the DOD think in terms of only the giant prime contractors such as Lockheed and Hughes; not in terms of these critical lower tier subcontractors. Gansler rhetorically asks why they (the Congress and DOD),

...assume that legislation, regulations, policies, and procedures should be applied equally to the large and the small contractors, to those that deal directly with the

government and those that deal through prime contractors; and to those that supply weapon systems and those who supply parts? [Ref. 7:p. 128]

Gansler asserts that there are "gross differences" between the upper and lower tiers of the DIB and that the application of uniform legislative and regulatory policy serves to amplify the existing problems within the DIB and the differences between its tiers. He believes these problems and differences are causing the exit of substantial numbers of lower tier subcontractors from the defense marketplace. [Ref. 7:pp. 129-130]

The exit of these firms from the DIB has been particularly acute in the semiconductor, shipbuilding, ball and roller bearing, foundry, forging and machine tool industries. According to Roderick L. Vawter, each of these industries in terms of capacity, technology, and international competitiveness is declining. [Ref. 17:pp. 39-52] The foundry, machine tools and forging industries are illustrative of this decline. Since January 1, 1980 more than 600 foundries have closed out of a total domestic foundry base of approximately 4000 foundries. [Ref. 18:p. 32] Since 1979, the machine tool industry has experienced a 75% decline in new orders and total employment has fallen by 65%. Imported high tech machine tools now account for over 50% of the market. [Ref. 19:p. 40] More than 90% of the semi-conductors used in this country are now produced offshore. [Ref. 20:p. vii]

Many of the lower tier subcontractors and suppliers in these industries are sole sources for the products they produce. Their exit from the defense marketplace is a critical, growing problem. The problem of diminishing and increasingly less capable sources is seen among both high technology subcontractors and suppliers of conventional parts. Table 2-1 illustrates a number of critical weapon system areas in which there are only a few subcontractors.

TABLE 2-1
CRITICAL AREAS WITH SMALL NUMBERS OF SUBCONTRACTORS

Equipment type	Number
Airborne radar systems	2
Aircraft Engines	2
Aircraft Landing Gears	3
Aircraft navigation systems	2
Infrared systems	2
Tank hull castings	1
RPV/drone engines	2

Source: Gansler, The Defense Industry, 1981.

The Defense Industrial Base Panel of the House Armed Services Committee recognized these problems and the erosion occurring in the lower tiers of the DIB. The panel, chaired

by Representative Richard H. Ichord, stated in December 1980 that,

...there has been a serious decline in the nation's defense industrial capability that places our national security in jeopardy. An alarming erosion of crucial industrial elements, coupled with a mushrooming dependence on foreign sources for critical materials, is endangering our defense posture at its very foundation. [Ref. 21:p. III]

The panel found that the general condition of the DIB had deteriorated and was in danger of continuing to deteriorate.

The panel specifically reported that:

- the defense industrial base was unbalanced; while excess production capacity generally exists at the prime contractor level, there are serious deficiencies at the subcontractor level;
- the industrial base is not capable of surging production rates in a timely fashion to meet the increased demands that could be brought on by a national emergency;
- lead times for military equipment have increased significantly during the past three years;
- the U.S. is becoming increasingly dependent on foreign sources for critical raw materials as well as for some specialized components needed in military equipment;
- productivity growth rates for the manufacturing sector of the U.S. economy are the lowest among all free world industrialized nations; the productivity growth rate of the defense sector is lower than the overall manufacturing sector; and
- the means for capital investment in new technology, facilities and machinery have been constrained by inflation, unfavorable tax policies, and management priorities. [Ref. 21:p. 11]

In the opinion of the researcher, these findings are as valid today, if not more so, as they were in 1980. The real impact of these problems becomes apparent when they are

studied collectively. The researcher has organized these factors into three interrelated categories loosely defined as: 1) the business base and market forces, 2) the prime contractor/subcontractor relationship, and 3) the legislative and regulatory environment. Each of these categories is presented and analyzed below.

3. Business Base and Market Forces

There is a great deal of turbulence and instability within the DIB. It is dramatically affecting the lower tier subcontractors and forcing their exit from the defense marketplace. [Ref. 3:p. 80] The Ichord Panel was very blunt on this point specifically stating that the

...lower tier subcontractors in the defense industrial base are generally hit harder by the instabilities in defense programs, have greater capital formation problems and suffer more from the burdensome paperwork associated with doing business with the government than their larger counterparts in the base. [Ref. 21:p. 13]

Much of this turbulence and instability is due to defense business base fluctuations and the impact of those fluctuations on the ability of a smaller subcontractor to efficiently perform, utilize capacity, and make necessary capital investments.

Shifts in defense market demand are generated by the Government and flow down from major prime contractors for many reasons. These shifts in demand can be due to unplanned program growth, significant program quantity changes, engineering changes, program cancellations and program stretch-outs. These shifts in demand are often

driven by unforeseen or uncontrollable budgetary, political and policy decisions.

Rapid increases in defense market demand bid up skilled labor prices and impact its availability. Leadtimes and costs increase as lower tier subcontractors struggle to produce unexpectedly increased quantities of parts, components and subassemblies used by the primes.

Dramatic turndown in demand also severely impact these lower tier subcontractors. As weapon systems are cancelled, stretched-out or gradually completed without follow-on contracts, overhead rates increase, workforces are reduced, capital investment decisions delayed, learning and technical capabilities lost.

The cyclical nature of defense spending, with its program and funding instabilities, low-volume highly specialized products, and shifting priorities often place the contractor in fear of cancellation or termination. [Ref. 11:p. 26] This pervasive business environment risk discourages a long-term business approach (by either the Government or the contractor) on most defense procurement programs and inhibits modernization or productivity enhancing investments. This is particularly true when the contractor is trying to maintain his profitability as measured by return on investment (ROI). Firms put greater emphasis on minimal investment levels with short pay off periods to keep their ROI high. [Ref. 11:p. 25] Government

and Defense business is a "program oriented business (where) a single program can account for 25% or more of a company's sales and profit." [Ref. 22:p. 2-110] Lack of long-range planning by the Government forces contractors into a reactive mode and does little to assist the contractor in the efficient allocation of equipment and resources for the long-term. These business risks and short term perspective are magnified for the subcontractor:

Not only does the subcontractor run the risk of a program being cancelled at the DOD level, but in addition, runs the risk of the prime contractor simply revising its make-or-buy decision and terminating for convenience. Further, the DOD fails to recognize, especially at the subcontractor level, the impact that changes in a subcontractor's commercial business can have upon its Government programs. Typically, the prime contractor has much greater flexibility, because of its size, to mitigate changes in its commercial business base. The subcontractor, on the other hand, is not generally of such size that it can perform major reorganizations and transfers of personnel to accommodate rapid changes in business base. [Ref. 22:p. 2-111]

In addition to these increased subcontractor business risks there appears to be much greater financial and profitability risks at the lower tiers as well. Gansler found a large difference in profitability between the large prime contractors and their lower tier subcontractors stating "in general, the small defense contractors (subcontractors and suppliers) have lower profits and far higher risks than the larger ones." [Ref. 7:p. 138] Gansler also believes that large companies for a variety of reasons,

...have almost no risk of losing money whereas the small operations have a very high probability of doing so...specifically...a larger firm is likely to make two or three times as much profit as a smaller firm, and with one-third to one-half the risk-the opposite of economic theory.... [Ref. 7:p. 141]

The lower profitability of defense subcontractors is often due to the difference in the amount of capital (both equipment and money) invested by the Federal Government in the large contractors but not the smaller ones. Investment made by the Government at the prime contractor level in the defense industry allows the prime contractors to realize large sales dollars with little investment of their own while this is not the case for smaller subcontractors. Gansler suggests that this may be true because the larger prime contractors have more negotiation power with the Government than smaller firms. However the overall lower profitability of both prime contractors and subcontractors is recognized by the capital markets making it more difficult to raise capital.

The smaller subcontractors of the DIB are often the least financially sound and have the most limited capital, facilities and managerial resources. This is certainly true relative to the larger prime contractors in the base. However the history of military technological breakthroughs, according to Gansler, indicates that "it has often been the small, inventor-led firms that have made the qualitative breakthroughs, so critical to military superiority of the U.S. forces." [Ref. 7:p. 128] The combination of these

business risks, lower profitability and difficulties in obtaining inexpensive capital are forcing subcontractors out of the defense marketplace with negative long-term consequences. These factors also erect significant barriers to new subcontractors, prohibiting easy entry into the defense marketplace and exit barriers to the large prime contractors.

4. Prime-Subcontractor Relationship

The relationship between the prime contractor and its supporting subcontractors is affected by many factors. This relationship can become anything from a stable, productive high quality relationship such as those developed by Japanese prime contractors with their subcontractors, to a bitter, adversarial, unstable relationship. Whatever the relationship, it begins in earnest after a Government contract award to a prime contractor. The prime contractor will visit all the subcontractors in its "make vs. buy" plan to review product and contractual requirements. Audits and inspections of the subcontractor's capabilities occur to establish compliance with Government requirements. On most defense programs, subcontractors are often under contract to supply quantities that are below the most economical production levels. [Ref. 22:p. 2-102]

The financial risks faced by the prime contractor and its budget concerns often reflect themselves in the contract negotiations between the prime and sub. These

negotiations usually result in a fixed price type contract for the subcontractor even though the prime may be under a cost reimbursement type contract with the Government. [Ref. 7:p. 146] This "risk-shifting" technique used by prime contractors often severely strains the prime-sub relationship. In one study of prime contractors with cost reimbursement type defense contracts, 85% of the primes' subcontracts were firm fixed-price. [Ref. 7:p. 146] Adversarial relationships often develop inhibiting long-range planning, managerial flexibility, technical innovation and communication between the prime and sub. This in turn promotes the short-term perspective in business decisions, reactive planning and discourages capital investment.

The subcontractor's products are subject to both Government and prime contractor inspection and data requirements. Government and prime contractor quality control requirements flow down to the subcontractor often becoming more stringent than what was originally called for by the Government as the prime builds in a "safety factor" for himself. [Ref. 7:p. 146]

Due to their size prime contractors have a number of advantages that smaller subcontractors do not have:

Because of size, prime contractors have an inherent leverage over subcontractors and too often abuse that leverage through overreaching. One example of overreaching is the way in which prime contractors use the

unfettered right to terminate subs for convenience for purposes other than those contemplated by Section 8 of the DAR. Another example is a tendency on the part of prime contractors to leverage one government program against the other in dealing with subcontractors. [Ref. 22:p. 2-104]

Prime contractors also have additional legal rights and remedies with the Government not available to subcontractors in their contractual relationship with the prime. One such example is Public Law 85-804, Extraordinary Contractual Relief. This law gives the Government the ability to financially and contractually "bail out" prime contractors threatened with bankruptcy if they are considered essential to the DIB. [Ref. 23:p. 63] While the law does not discriminate between prime contractors and subcontractors, the researcher is only aware of prime contractors such as Lockheed and General Dynamics benefitting from it. The literature often cites the reluctance of a prime contractor to flow down "favorable" clauses from the prime contract to the subcontract. Often only the restrictive provisions of the Federal Acquisition Regulation (FAR) flow down to subcontractors. Aerospace subcontractors have specifically noted that the beneficial provisions of programs like MANTECH and IMIP are rarely flowed down. [Ref. 22:p. 2-103]

The "make vs. buy" decision by the prime contractor is also a critical factor affecting the subcontractor base and the prime-sub relationship. Vertical integration of manufacturing processes at the prime contractor level,

...is eroding the subcontractor base. Components and assemblies that in 1960 would have been assigned to a specialized subcontractor to design and build are now designed by the prime contractor and, in many cases, also built by the prime. [Ref. 22:p. 2-105]

Many factors exist to encourage the "make" decision by the prime contractor. The "make" decision has the effect of increasing the prime's market power, workforce flexibility and the ability to absorb more overhead. The "make" decision also gives the prime greater control over the engineering design and allows the prime to retain his workforce and operate at near capacity when cyclical defense demand begins to drop. This practice in turn amplifies the turbulence at the lower level tiers as the primes use the "make" decision to retain work during downturns and the "buy" decision during the upturns. This, in effect, "is a way for the prime contractors to shift the risk of doing defense business onto the subcontractors." [Ref. 7:p. 133]

This long-term trend of vertically integrating the manufacturing process has the effect of making the prime both a customer and competitor on various defense programs and ultimately reduces competition and raises prices. The "make" decision also often has the effect of restricting technological innovation and development at the lower tier subcontractor level. As the prime "makes" more at his level, engineering expertise, technical innovation, sophisticated equipment and manufacturing processes "imbed" themselves at the prime level. This in turn nurtures the

relationship between the prime contractor and the defense program manager, who in stressing state-of-the-art technologies for incorporation into new weapon systems, supports the "make" decision of the prime instead of the better "buy" decision for the DIB.

5. Legislative and Regulatory Environment

The legislative and regulatory requirements placed on both prime contractors and subcontractors are also creating a business environment where capable contractors decline to become involved with defense contracts. [Ref. 21:p. 6] The current emphasis on price competition by the Congress and Department of Defense is just one important example. According to the Costello draft study on a "Strategy for Bolstering Industrial Competiveness," price competition,

...effectively precludes the development of long-term relationships between prime contractors and suppliers and stimulates an adversarial relationship between them. The absence of long-term relationships does not permit extended, cooperative design, development, and manufacturing exchanges between the primes and suppliers. [Ref. 5:p. V-8]

Free and open price competition for subcontractors and suppliers, according to this draft study, has the effect of keeping the lower tiers of the defense industrial base in "constant turmoil" and make it "virtually impossible" for defense contractors to build and maintain a base of reliable, high, quality, efficient vendors. [Ref. 5:p. V-8]

The emphasis on price competition is just one factor in an almost overwhelming set of legislated and regulatory requirements facing the prospective defense contractor. These requirements are so daunting that,

...many of the best qualified suppliers (refuse) to participate due to their reluctance to become involved in complex, expensive, and non-productive government rules and regulations. Many desirable, highly-qualified suppliers refuse to do business with DoD prime contractors because of the sheer weight of compliance with the body of laws, regulations, rules, and procedures that primes are required to pass through from the government to them. This narrows the range of potential suppliers and reduces competition. [Ref. 5:p. V-8]

From the defense subcontractor perspective, commercial work almost always appears to be more attractive than defense work due to these flow down administrative burdens and their costs. This is particularly true during economic upturns when demand is high and available capacity is being utilized. In testimony before the Ichord Panel, subcontractors stated that they suffered more from the paperwork requirements associated with defense business than the large prime contractors. [Ref. 21:p. 13] Gansler illustrates this problem by citing the following administrative requirements which a defense contractor has to understand and complete to successfully perform on a defense contract. These requirements are for a relatively unsophisticated, small quantity item:

- DoD 250 special shipping documents on small dollar orders,
- changes in accounting systems to satisfy the Cost Accounting Standards Act (P.L. 91-379)

- data to satisfy the Truth in Negotiations Act (P.L. 87-653)
- records reflecting compliance with various socioeconomic programs, such as Equal Opportunity, Walsh-Healy, Small Business, and Labor Surplus Utilization,
- records reflecting compliance with inspections and testing requirements, such as MIL-I-45208,
- technical manuals and provisioning requirements beyond normal commercial manuals, and
- a multitude of "boiler-plate" provisions which require the advice of a lawyer. [Ref. 7:pp. 146-147]

Even these "minimum" requirements necessitate that any defense contractor maintain a considerable staffing overhead for administration and compliance with them. According to Gansler, these provisions are not necessary for small firms and are not cost effective either for the firm or the Government. These requirements create higher overheads for these firms and prevent them (should they accept the business) from being competitive in the commercial marketplace.

The literature provides numerous other reasons which cause firms to exit the defense marketplace or remain out of it. Each reason contributing in its own way to the erosion of the base. Restrictive profit and tax policies are two examples. [Ref. 21:p. 1] The ongoing controversy over defense industry profit levels (with the perception by many in Government that profits are too high and the perception by many in industry that they are too low) as well as the

various methods for "computing" profits is often cited as a reason for exiting the DIB. [Ref. 24:pp. 1-3]

In March 1988 the Aerospace Industry, Electronic Industry and National Security Industrial trade associations presented Secretary of Defense Frank C. Carlucci a study that examined the impact of piecemeal major statutory, regulatory, and management practice procurement changes on the defense industry. The study was entitled, "The Impact on Defense Industrial Capability of Changes in Procurement and Tax Policy (1984-1987)" and was conducted by the MAC Group, an international management consulting firm. The study concluded that:

- ROI has been less than the return necessary to maintain shareholder value,
- profits have been reduced by an average of 23 percent on the companies' defense business,
- companies are being forced to borrow heavily and equity capital is not a likely funding source,
- the changes will result in a less efficient industry,
- competition will be reduced because fewer competitors will be willing to bid on future programs, and
- a financially-weakened industry will be less able to compete against growing and sometimes subsidized foreign competition. [Ref. 24:pp. 2-3]

According to the study, the implications of these conclusions are:

- less independent research and development,
- pursuit of low risk technology alternatives,
- inability to attract the best people to the industry,

- financially weakened subcontractors, and
- a significant industry restructuring and consolidation.
[Ref. 24:pp. 2-3]

Low defense profitability often translates as "more attractive commercial ventures" when these firms are surveyed on their reasons for leaving the DIB. Government procurement policies and bidding practices are cited, often in the context of being unfair, "rigged," or impossible to understand due to incomplete specifications or complexity. The growing use of "offsets" associated with Foreign Military Sales moves critical lower tier subcontractor work offshore. The on-again off-again nature of defense market program demand, overly restrictive specifications, quality and data requirements, multiple uncoordinated auditing and inspecting requirements all contribute. Environmental Protection Agency (EPA) and Occupational Safety and Health Act (OSHA) requirements are universally cited by the foundry industry.

Two recent studies have studied the reasons why capable companies leave the defense market place or refuse to enter it. The first study was a December 1986 Master's thesis by Lt. William H. Gaffney and attempted to determine the effectiveness of procurement workshops conducted by the Navy Office of Legislative Affairs (OLA). Part of his study asked two questions of a selected sample of attendees regarding their attitude towards Government business. The first question asked:

If you have not done business with the Government, do you intend to do so in the future?

Nineteen percent (18 firms) answered in the negative. The reasons cited for the negative response were:

Reason	Number
a. not interested	2
b. too hard/complicated	6
c. burdensome paperwork	3
d. instability of Govt business	1
e. Govt bidding methods	4
f. low profitability	4
g. other	2

The second question asked:

If you are doing business with the Government, do you intend to quit?

In this case only 6.4% of the companies responding (9 of 132) indicated they were going to quit. The primary reasons were unfair application of regulations, more attractive commercial ventures and contract award delays. [Ref. 25:pp. 99-100]

A second, more detailed study was conducted by Dr. David V. Lamm in March 1987. It focused on the reasons why capable companies refuse to participate in defense business. Lamm surveyed a total of 1317 companies from various industries and had a survey return rate of 32.4% (427 firms). One of the critical questions in the Lamm survey was question #9:

What are the primary reasons you are NOT NOW involved in Defense business or intend to GET OUT.?

Out of the total 427 returned surveys 213 companies answered question nine affirmatively. One hundred twenty two of

these companies (57.2%) indicated they wanted DOD business but had significant problems. Ninety One companies (42.8%) indicated they did not want DOD business. These 91 companies (companies refusing to do business with the government), represented 21.3% of the returned surveys. [Ref. 16:pp. 68-72] The top six reasons for refusing Government business or for getting out of Government business are shown in Table 2-2.

TABLE 2-2
KEY REASONS FOR REFUSING DOD BUSINESS

Reason	Frequency	%	Cited:	
			1st	2nd
Burdensome Paperwork	147	69.0	60	26
Government Bidding Methods	121	56.8	22	31
Inflexible Procurement Policies	81	38.0	7	13
More Attractive Commercial Ventures	73	34.3	7	9
Low Profitability	69	32.4	10	6
Government Attitude	69	32.4	3	10

Source: Lamm, "An Analysis of Reasons Companies Refuse to Participate in Defense Business," unpublished Naval Postgraduate School research paper, 1986.

These results substantiate the more limited Gaffney findings and illustrate some of the principal reasons for refusing

DOD business. It is interesting to note that the top three reasons are all a function of the various legislated and regulatory requirements levied on the defense acquisition system. Tabular summary data from the Lamm surveys on the reasons why companies refuse to participate in defense business was presented in the Winter 1988 National Contract Management Journal and is contained in Appendix A.

D. DEFENSE INDUSTRIAL BASE SUMMARY

The preceding chapter segments were designed to present the reader with an overview of the factors affecting the lower tiers of the DIB and contributing to its erosion. In the opinion of the researcher, the DIB is declining in absolute numbers of firms, productivity, international competitiveness and (in many areas) capacity. This decline carries with it serious implications for National Security Policy, particularly with respect to potential surge and mobilization requirements.

Three interrelated sets of factors appear to be driving businesses from the DIB. Those related factors are: 1) an unstable business base and its market forces, 2) an adversarial risk-shifting prime-subcontractor relationship, and 3) an overwhelming legislative and regulatory environment. All these factors appear to much more dramatically affect the lower tier subcontractors than the primes. These forces are causing the supporting tiers of the DIB to shrink as subcontractors exit the base. These

forces are creating entry and exit barriers to this market as well. Many specific reasons are cited for this shrinking base throughout the literature. The most significant reasons appear to be consistently related to:

- excessive, burdensome Government administrative requirements,
- inflexible procurement policies and bidding methods, and
- the cumulative, negative impact of profit, tax and regulatory policies.

The collective impact of these factors combined with the various business risks previously discussed has the effect of forcing subcontractors out of the DIB and into a more "attractive" commercial market place. This situation was informally summed up for the researcher by a foundry industry subcontractor. This subcontractor told the researcher that DOD work is "...just too damn hard, too damn complicated and too damn risky." The following, concluding portion of this background chapter provides an overview of the foundry industry its current problems/issues.

E. THE FOUNDRY INDUSTRY

1. Introduction

This concluding chapter segment presents a foundry industry overview for the reader. The industry's role in the U.S. economy is presented along with a description of its demographics and casting processes. Significant industry trends, problems and issues are reviewed and the importance of U.S. nonferrous foundries to the DIB is

addressed. The chapter concludes with a brief explanation of why the foundry industry was chosen for this study.

2. Foundry Industry Overview

The United States foundry base contains between 3400 and 4200 foundries. [Refs. 26:p. 2; 27:p. xiii; 18:p. 32; 28:p. 1] The actual size of the domestic foundry base is difficult to estimate due to inaccurate, inconsistently collected data and the particular definitions and assumptions concerning the industry being used by the researcher. In the opinion of this researcher the current domestic foundry base consists of slightly less than 4000 foundries. This opinion is based on data available to the researcher from the 1987 Foundry Management and Technology Census and numerous discussions with foundry trade association representatives.

Despite a significant decline in its size over the last two decades, the U.S. foundry industry is a giant in the world foundry market. The United States is the world's largest producer of castings accounting for an average 25% share of total world production. The United States is also the largest producer of nonferrous castings as well, accounting for 26% of total world production. [Ref. 27:p. 4] Foundries represent the fifth largest manufacturing industry in the United States and produced \$15 billion worth of castings for over 50,000 different customers last year. [Ref. 28:p. 1]

Foundries produce castings products which are "...used in 90% of all manufactured goods and in all capital goods machinery used in manufacturing." [Ref. 27:p. xiii] These castings run in size and weight from one ounce artificial heart valves to multi-ton tank turrets and hundred ton presses. Castings are usually manufactured to be components of finished goods produced by other manufacturers. Because castings are used in so many manufacturing processes and products the foundry industry is one of the most basic components in the American industrial economy. [Ref. 26:p. 2]

Metals used by domestic foundries can generally be described as "ferrous" (iron derivative metals/alloys) or "nonferrous" (non-iron base metals such as aluminum, zinc, copper, titanium, etc.). These ferrous and nonferrous metals are used in two basic types of foundries: production foundries and jobbing or contract foundries. These foundries differ in the quantity and types of castings they produce. Production foundries concentrate on a few, high production volume products while the jobbing foundry concentrates on producing a large variety of smaller quantity, "custom" castings. Both types of foundries can be further categorized as "jobbing" or "captive" foundries. These distinctions are used to describe whether the castings produced are used by external customers (jobbing production) or by the foundry itself (captive production). These

distinctions are often at the root of the differences in various industry census statistics. Jobbing foundries constitute the vast majority (over 80%) of the domestic foundry base. Over 96% of all foundries in the United States employ 500 or fewer workers. [Ref. 26:p. 2] This employment statistic defines these foundries as small businesses according to Part 19 of the Federal Acquisition Regulation (FAR). [Ref. 29:p. 19.6-1]

Approximately 60% of the domestic foundry industry now casts primarily with nonferrous metals. [Ref. 26:p. 2] These nonferrous foundries are particularly critical to DOD and produce castings which have widespread applications in weapon systems-particularly in aerospace systems. These nonferrous foundries cast primarily with aluminum and have been operating at above 70% of capacity since the early 1980's. [Ref. 30:p. 1] This average operating capacity statistic is important because it indicates that the nonferrous foundry (cast aluminum) segment of the industry is utilizing most of its available capacity. This suggests that DOD demand for castings has to "compete" with strong commercial demand for the available capacity. As discussed earlier in this chapter, commercial demand is often perceived to be more "attractive" than DOD demand. As a consequence of this perception, any decline in capacity has the effect of "squeezing out" DOD demand as commercial demand utilizes available capacity. Figure 2-3 presents a

summary analysis of the foundry industry broken down by employment, cast metal type and production usage.

ANALYSIS OF THE FOUNDRY INDUSTRY

(Number of plants, U.S. and Canada)

BY EMPLOYMENT:	1986	1983	1980	1978	1975	1973	1971
Over 1,000	23	29	52	46	61	53	49
500 to 999	61	57	73	70	83	77	73
250 to 499	146	180	224	222	232	218	210
100 to 249	513	572	619	634	628	614	606
50 to 99	619	656	702	701	721	715	711
20 to 49	982	1,039	1,074	1,148	1,109	1,128	1,169
Under 20	1,662	1,827	1,901	2,008	2,104	2,266	2,436

BY MAJOR METAL CAST:

Gray and ductile iron	1,063	1,165	1,343	1,414	1,452	1,497	1,530
Malleable iron	30	42	53	55	62	65	70
Steel	455	500	490	494	457	437	427
Nonferrous metals	2,458	2,653	2,759	2,866	2,967	3,072	3,227

BY JOBBING-CAPTIVE:

Exclusively jobbing	2,586	2,750	2,925	3,025	3,342	3,417	3,494
Primarily jobbing	634	717	729	762	532	512	500
Exclusively captive	454	504	590	635	659	721	815
Primarily captive	332	389	401	407	405	421	445
ALL PLANTS:	4,006	4,360	4,645	4,829	4,938	5,071	5,254

Source: "Metalcasting Industry Census Guide," Foundry Management and Technology, April 1987.

Figure 2-3 AN ANALYSIS OF THE FOUNDRY INDUSTRY

Casting as a manufacturing process has many advantages over other forms of metal forming including the large variety of complex shapes with high dimensional

accuracy which can be produced. Castings are produced in a manufacturing process "...by which liquid metal is poured or injected into a mold cavity, allowed to cool and solidify, and then released from the mold for finishing and use."

[Ref. 27:p. 1] Castings are widely used because of the options they afford the manufacturer in terms of product size, complexity of design, metal content, surface finish and near-net shape. There are seven basic casting processes:

- sand casting
- shell mold casting
- plaster mold casting
- investment casting
- permanent mold casting
- centrifugal casting, and
- die casting.

Three of these processes are particularly important to DOD applications and are briefly described below.

a. Sand Casting

Sand casting is the simplest and most widely used process accounting for more than 90% of all castings produced. Essentially, it consists of forming a cavity in special sand compounds with a pattern, filling the cavity with liquid metal, allowing it to cool and then breaking away or "shaking out" the sand. This process is inexpensive, can be used for large, heavy castings such as

construction fittings and tank components but is less dimensionally accurate than other methods.

b. Investment Casting

Investment casting is also known as the "lost-wax process" and uses wax or plastic injected into a metal die to form a pattern. The pattern is surrounded by refractory material. When liquid metal is poured into these patterns, the wax or plastic melts and is "lost." Liquid metal fills the remaining cavity. Extremely complex castings can be produced using this process with great precision and dimensional accuracy. Any metal type can be used in this process and castings up to a size of approximately ten pounds can be made. Common commercial products include scientific instruments, computer parts, jewelry. Many aerospace castings are manufactured out of non-ferrous metals using this process.

c. Die Casting

Die casting is a process where liquid metal is forced, under high pressure, into a metal die cavity. The metal is held under pressure until it solidifies, then the die is opened and the casting ejected from it. This process is extremely quick, and results in a near-net shape casting requiring little finishing. Die castings can be produced with great dimensional accuracy but are usually limited to non-ferrous metals and a ten pound maximum size. Commercial products include aluminum transmission cases and aircraft

parts. A wide variety of DOD cast products are produced this way. [Ref. 27:pp. 2-3]

The foundry industry is repeatedly identified in the literature (along with the forging, semi-conductor, machine tool and bearing industries) as critical to the DIB and a potential industrial bottleneck. [Ref. 17:pp. 39-52] Numerous domestic and international pressures have caused a major restructuring of the industry during the last two decades. The next section of this chapter will explore the magnitude of this restructuring and the most significant factors causing it.

3. Current Problems and Issues

The foundry industry is a large, diverse, lower tier industry in the DIB. Because of the pervasive use of casting products as components in finished goods, "...the health of the industry is closely aligned with the general state of the economy." [Ref. 27:p. xiii] Its performance over the last ten years has not been up to historic levels and there is widespread concern that its competitive position in both domestic and foreign markets is eroding. [Ref. 27:p. xiii] The industry suffered a significant downturn in numbers of firms and in capacity during this period and many policymakers are concerned over the effect this will have on the DIB. Policymakers have are concerned because castings tend to be "bottleneck" items with long leadtimes. [Ref. 1:p. 5-1] This is particularly true when

one considers the complex, highly specialized nature of the cast parts usually required by DOD. Many foundries are sole source suppliers of critical defense castings and the significant decline in the total number of foundries in the last two decades has dramatically reduced the number of potential suppliers. Titech, a company specializing in precision titanium castings is one such example. It is the sole source supplier of the wings for the Sparrow missile. [Ref. 1:p. 5-7] More importantly, it is one of only three titanium casters left in the United States. [Ref. 1:p. 5-15]

The DOD consumes at least ten percent of the total annual domestic production of castings for weapon and logistics systems. [Ref. 28:p. 1] For investment castings, DOD consumes an astonishing 42% of total annual output. [Ref. 31:p. 3] The use of castings throughout DOD is pervasive and general applications of castings in defense systems are used for

...engine and engine components, powertrain components, structural components and some armament components. Examples of Army products reliant on castings are tanks, trucks and artillery. The Navy utilizes castings, for example, in submarines for critical hull and machinery applications, such a diving, propulsion and weapon handling systems. Navy surface ships also require castings in the hull, power, and armament systems. Aircraft in all services use castings in the fuselage as well as in engine accessories. Castings are also used in missiles, bombs, artillery, and small arm components. Besides their front-line role, castings are essential components of defense production equipment and logistics systems. [Ref. 32:p. 14]

Specific examples of current weapon systems heavily dependent on nonferrous state-of-the-art casting products are: [Ref. 33:p. 557]

- the U.S. Navy Phalanx Gun mount and housing,
- the Harpoon Missile Torpedo nosecone,
- the Advanced Lightweight Torpedo body,
- the Air Launched Cruise Missile fuselage, and
- any modern combat aircraft.

Given the importance of the casting industry and its products to the DOD, it is particularly disturbing to study the various conclusions on the health of the industry.

Roderick Vawter concluded in a December 1986 National Defense University study entitled, "U.S. Industrial Base Dependence/Vulnerability," that the overall capacity and competitiveness of the foundry industry was declining. [Ref. 17:p. 50] Between the period of 1979 to 1983, shipments were down 38%, sales down 21% and employment down 40%. Profits declined from \$1.6 billion in 1979 to a \$527 million loss in 1983. [Ref. 17:p. 50] While some segments of the industry did better than others during this recessionary period, constant dollar sales for the entire casting industry declined by nearly 40% during the period of 1972 to 1982. [Ref. 1:p. 5-8] James A. Mallory, Executive Director of the Nonferrous Founders Society and Bob Rodgers, editor of Foundry Management and Technology magazine both told this researcher that there has been a 20% decline in

the numbers of domestic nonferrous foundries in the last ten years and that 15% to 18% of overall capacity has been lost. [Refs. 34,35]

For various reasons substantial numbers of foundries are exiting the domestic market. A

...review of publicized foundry closings in the trade press as well as data supplied by foundry industry trade associations reveals that from January 1, 1981 to December 31, 1984, 612 ferrous and nonferrous foundries, about 14 percent of the total number of foundries, were shut down. Although no capacity data are available for these foundries, employment data indicate that most were in the medium to small category. For instance, only 3 closed foundries had more than 2,500 employees, and 13 had 250-499 employees. The remaining closed foundries had less than 250 employees. [Ref. 18:p. 32]

Tables 2-3 and 2-4 are an analysis of foundry closings by employment size and by type of metal cast using the Ladehoff data. The decline in absolute numbers of domestic foundries is even more dramatic for the period 1955 to 1980. Figure 2-4 illustrates the 25 year decline in this basic industry.

Vawter believes the decline in this fifth largest manufacturing industry is due to the fact that the industry has not been "...cost competitive with foreign producers, in terms of labor, capital, exchange rates, cost of tooling and patterns and government regulations affecting cost." [Ref. 17:p. 51] Examples of costly Government regulations include the strict enforcement of various EPA and OSHA regulations. There is a widespread belief that enforcement of these regulations has contributed to the economic factors "...forcing a large number of foundries to close." [Ref. 1:

TABLE 2-3

NUMBER OF FOUNDRY CLOSINGS BY TYPE OF METALS CAST
JANUARY 1, 1981 TO DECEMBER 31, 1984

	<u>FERROUS</u>		<u>NONFERROUS</u>
Steel	78	Aluminum	130
Gray Iron	253	Brass & Bronze	87
Ductile Iron	20	Magnesium	1
Malleable Iron	7	Zinc	22
		Other	14
Totals:	358		254

Source: Laderhoff, "Restructuring A Changing Industry,"
Foundry Management and Technology, 1985.

TABLE 2-4

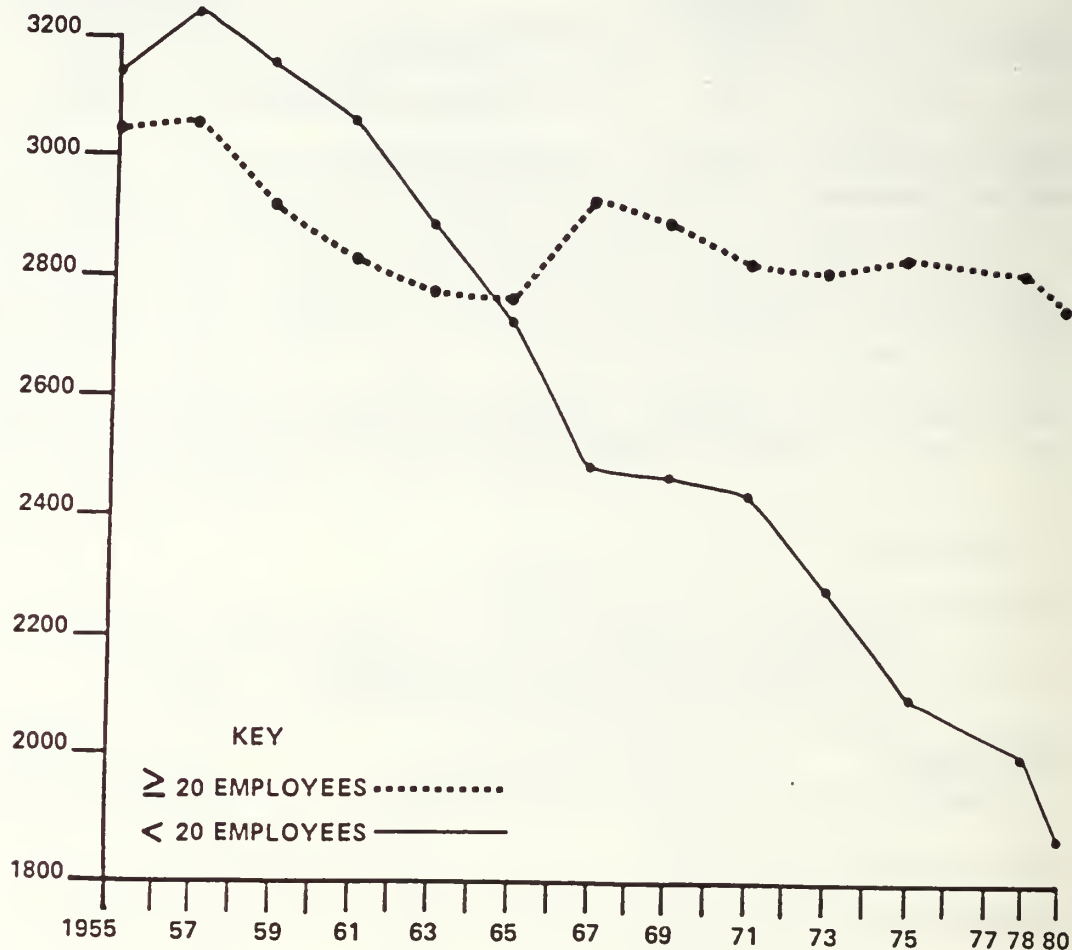
FOUNDRY CLOSINGS BASED ON EMPLOYMENT SIZE
JANUARY 1, 1981 TO DECEMBER 3, 1984
ALL FOUNDRIES OPERATING JANUARY 1, 1981

<u>EMPLOYMENT</u>	<u>CLOSED FOUNDRIES</u>		<u>TOTAL FOUNDRIES</u>	
NO.	NO.	%	NO.	%
1-9	175	29	1058	25
10-19	87	14	705	17
20-49	125	20	999	23
50-99	84	14	605	14
100-249	87	14	587	14
250-499	30	5	207	5
500-999	11	2	62	1
1000+	13	2	42	1
TOTALS:	612	100	4256	100

Source: Laderhoff, "Restructuring A Changing Industry,"
Foundry Management and Technology, 1985.

TRENDS IN THE NUMBER AND SIZE OF FOUNDRIES

NO. OF FOUNDRIES



Source: GAO, "Potential Impediments of Foundry Capacity Relative to National Defense Needs," EMD-81-134, September 15, 1981.

Figure 2-4 TRENDS IN THE NUMBER AND SIZE OF FOUNDRIES

p. 5-8] Other causes of competitive disadvantages include foreign government subsidization of domestic foundries, foreign trade and regulatory barriers. Unfavorable domestic capital formation and taxation policies are repeatedly cited as "sharply" discouraging capital investment and interfering with our ability to compete internationally. [Ref. 28:pp. 12-13]

American foundries are increasingly less efficient and technologically innovative relative to its foreign competitors, such as Japan. High levels of technical efficiency have been achieved by German, British and Japanese competitors due to higher levels of capital investment and more favorable tax policies. These factors have created a significant price advantage for Japanese castings. Foundry Management and Technology estimates that 20% percent of the Japanese price advantage is due solely to their capital investments in more efficient casting technologies. [Ref. 31:p. 8] In addition to competing with highly efficient foundries such as the Japanese, American foundries are increasingly competing with nations such as Brazil, India, and China who have used protectionist trade policies and cheap labor costs to penetrate the American market with simple, mass produced castings. Import penetration, according to the American Cast Metals Association,

...has been and is expected to continue to be most significant in the area of standardized, simple-to-manufacture, price sensitive castings, such as iron construction castings, fittings and valves. [Ref. 28:p. 9]

The importation and "alleged" dumping of cast products from these countries has been the subject of at least one petition with the International Trade Commission (ITC) by industry associations requesting that tariffs be placed on these types of cast products. However, the petitions were not supported by the ITC and the tariffs were never enacted by the president. [Ref. 37:p. 19-8]

The magnitude of import penetration is hard to gauge and has been officially estimated at three percent of the U.S. market. However these figures do not account for the castings entering the U.S. under other classifications such as finished products, components and as parts of finished products. [Ref. 36:p. 10] The increasing importation of finished assemblies and manufactured goods containing castings represent lost production for U.S. foundries and may have a greater potential impact on domestic foundries than the importation of castings themselves. [Ref. 27:p. 20]

A significant decrease in domestic demand for castings has also affected the foundry base. Major industrial consumers of castings such as the auto and machine tool industries have been restructuring due to their own international competition as well as other factors. The

drop in demand for domestic autos, machine tools and other finished goods has created a tremendous decline in demand for cast parts. Fewer and lighter castings are now being used in all finished goods and materials such as plastics are being increasingly substituted for formerly cast metal parts.

F. FOUNDRY INDUSTRY SUMMARY

Increasing supply, and decreasing demand, combined with intense international competition, unfavorable domestic tax policies and regulatory costs, have forced substantial numbers of foundries out of the domestic base reducing its capacity and capabilities. Increasing numbers of the remaining firms are "sourcing-out" remaining production overseas. [Ref. 28:p. 11] These factors have created well-founded concern over the ability of the lower tier domestic (particularly nonferrous) foundry base to support upper tier prime contractors in the DIB. These concerns are founded primarily on the huge "bottleneck" effect a few critical foundries could have on a large number of DIB contractors. Individually, each of these economic and political factors is manageable; collectively, these factors create powerful forces which, in the opinion of the researcher, will continue to drive foundries out of the lower tiers of the DIB. In the opinion of the researcher, the remaining foundry base, when given the choice between commercial ventures and Government related business, will almost always

choose the more attractive commercial ventures. This is particularly true for our domestic nonferrous foundries which are already operating at nearly full capacity. The foundries that do stay in DOD subcontract work probably do so because the exit barriers from that market are too high. This situation will have the effect of creating a limited number of foundries with the capital, equipment and technical capabilities to successfully produce high quality DOD castings. This will occur in much the same way that the relatively few, large prime contractors such as Lockheed, Hughes, FMC and Electric Boat, gradually found themselves in a market they could not exit, and that the Government found it could not substantially expand.

Given the significant forces causing foundries to exit the domestic market and the critical importance of the foundry industry to the DIB, it becomes essential to the DIB planner to understand the capacity, capabilities and motivations of the foundries left in the base. Earlier in this chapter, evidence was presented from Dr. David V. Lamm that 20% of the businesses he surveyed intended to get out, or stay out, of doing business with the Government. If this research finding is valid, another fifth of our diminishing domestic foundry base could potentially be refusing (or intending to refuse) to accept such business. Because of this potential, the researcher decided to target the foundry industry for a more detailed study on these attitudes

towards doing business with the Government. Nonferrous foundries were specifically targeted for this research due to the widespread use of its cast products by prime contractors in critical, state-of-the-art weapon systems. A secondary benefit of studying the foundry industry as opposed to other critical industries previously identified was the fact the almost all of the domestic foundry base is composed of small businesses in the little studied lower tiers of the DIB. The next chapter in this study presents the research methodology used in the researcher's attempt to answer the primary and subsidiary research questions concerning foundry industry attitudes on doing Government business.

III. SURVEY BACKGROUND AND DEVELOPMENT

A. INTRODUCTION

Throughout this study, the researcher has stated that continued concern over the erosion of the Defense Industrial Base (DIB) has resulted in numerous studies to determine its extent and causes. In Chapter II the researcher cited literature which strongly suggested that the problems causing the DIB to erode at the prime contractor level are probably more acute at the supporting lower tier subcontractor level. Yet, a thorough research of the current literature provided little objective data on the actual economic and productive health of those lower tier subcontractors. Virtually no current data could be found on foundry industry subcontractors.

General statements indicating subcontractors are exiting the defense marketplace (creating longer leadtimes, higher costs and potential industrial bottlenecks), are made but not sufficiently substantiated. Given that approximately 50% to 70% of our "eroding" DIB is composed of subcontractors, and that over half of all procurement dollars are spent at the subcontractor level, what are the extent and reasons for this hypothesized erosion at the subcontractor tier level? What specifically is causing foundries to drop out of the DIB and not participate in DOD business? How

significant and widespread is the problem? This chapter explains the survey methodology and the rationale for the survey questions asked in the attempt to answer these questions.

B. SURVEY DEVELOPMENT AND METHODOLOGY

The focus of this research was on subcontractors who refuse to participate in DOD business. The primary research objective was to determine the extent of this refusal and the most significant reasons for it. The researcher had to narrow the scope of this effort to an industry which was essential to the Defense Industrial Base (DIB) and could be expected to be composed primarily of subcontractors. Because of these requirements, the nonferrous foundry industry was chosen for the survey methodology employed by the researcher.

A 42 question survey was used to determine whether significant numbers of foundry subcontractors were contributing to the erosion of the DIB base by refusing, or intending to refuse, to participate in DOD business. The survey had five overall objectives:

1. to obtain descriptive data on the domestic nonferrous foundry base,
2. to target, through the use of "filters" in the survey, only those nonferrous foundries that were subcontractors and possessed the attitude that they were going to stay out or get out of DOD business,
3. to determine the relative importance of various reasons for staying out, or getting out, of DOD business,

4. to determine the most important reason for staying out or getting out of DOD business, and
5. to determine under what conditions a foundry would consider getting back in to DOD business.

In order to elicit candid, honest answers and to improve the survey return rate, respondents were informed that all responses were confidential and would be used on a strictly non-attribution basis. A cover letter from the American Foundryman Society and from the researcher emphasizing the confidential nature of the survey, its objectives and goals accompanied each survey. The entire survey and its cover letter is contained in Appendix B.

The overriding consideration in the development of the survey was to obtain data which would answer the primary and subsidiary research questions from a foundry subcontractor's point of view. During the development of the survey a significant effort was put into using close ended questions that would have a single "best" answer which the respondent could simply choose from a range of possibilities. With some of the questions this was not possible, but these were kept to a minimum and were generally descriptive in nature.

A "chunk survey" methodology was used to survey the targeted nonferrous foundry population. A chunk survey looks at a convenient slice of a population. It is really an investigation carried out by a researcher on a specific class of a population which fits a particular description or set of requirements. A chunk survey is dependent upon

finding respondents who fit the requirements and who are willing to answer the survey questions. Because the foundries surveyed were not chosen using a random sampling procedure, probabilistic conclusions can not be made about the data obtained. Although a random sample is much more desirable, useful results can be obtained from chunk surveys "...particularly in the arts of questioning and interviewing...." [Ref. 38:pp. 14-15]

Numerous Government and commercial databases were examined in order to obtain a significant sample size from this nonferrous foundry population to survey. Four databases were examined in detail in an attempt to obtain survey candidates. These databases were the: 1) PASS (Procurement Automated Source System) database maintained by the Small Business Administration, 2) DINET Defense Industrial Network database maintained by the Office of the Secretary of Defense (OSD), 3) Dun and Bradstreet Market Services commercial database, and 4) American Foundrymen's Society membership database. These databases were used to develop a survey candidate mailing list of 1,326 nonferrous foundries.

The initial survey list of 1,326 foundries represented approximately 65% to 108% (all percentages have been rounded to the nearest whole percent) of the total nonferrous foundries in the United States, depending on which population data were used! The wide range in the estimated percentage of the total population surveyed was due to the

fact that throughout this research effort, a single, authoritative foundry population census could not be found. Estimates of the total number of domestic nonferrous foundries ranged from the high Nonferrous Founders Association estimate of approximately 2,000 to the low DINET estimate of 1,231. Dun and Bradstreet Market Services lists 1,952 and the American Foundrymen's Society lists approximately 1,500 nonferrous foundries. The wide range in these census figures was attributed to lack of consistent data collection and the use of differing definitions as to what constitutes a particular type of foundry. These definitional issues were previously discussed in Chapter II. After analyzing all the data, the researcher concluded that the American Foundrymen's Society estimate of 1,500 foundries appeared to be the most accurate. It also was the most consistent in size relative to other data (such as total domestic foundry output/capacity) analyzed by the researcher. Using a baseline of 1,500 foundries from the American Foundrymen's Society database, the researcher estimated that approximately 88% of domestic nonferrous foundries were included in this survey. A survey sample size of approximately 88% of the total domestic nonferrous foundry base was considered to be of sufficient size to provide meaningful data for analysis. The actual survey mailing list was developed from data extracted from the

PASS, Dun and Bradstreet and American Foundrymen's Society databases.

Of the initial 1,326 surveys mailed, 27 were eventually returned as undeliverable and five were returned because the addressee was no longer in the foundry business. This left 1,294 potential respondents to the survey. A one month survey return period was used as a cutoff point after which data analysis would begin. During the one month return period 244 surveys were received for an overall return rate of 19% (244/1294). For a "blind" survey mailing, this return rate was considered acceptable for the purposes of this researcher. Eighteen surveys were returned after the one month cutoff period and were not used in this analysis.

The survey methodology employed two critical "filters" to identify foundry subcontractors who refused, or intended to refuse, to participate in DOD business. Of the 244 surveys which were returned in time for analysis, 196 (80%) did not pass these filters and 48 (20%) did. These survey "filters" are discussed in detail later in this chapter.

The individual answers provided by the survey respondents in each of these two groups was recorded and stored in the form of data vectors in "no-pass filter" and "pass filter" data files. The collective data vectors formed data matrices which were then analyzed using an IBM programming language known as APL-A Programming Language, and an IBM statistical analysis program known as GRAFSTAT.

When used together, APL and GRAFSTAT can provide the researcher with powerful graphical tools to organize and analyze large data sets. The graphical analysis of the survey data that follows was the result of using APL and GRAFSTAT to analyze the survey data obtained.

C. THE SURVEY QUESTIONS

The survey began with the following explanatory introduction:

This survey is designed to solicit your ideas and concerns about Department of Defense (DOD) procurement policies and procedures at the subcontractor level. The goal of the survey is to determine why firms do not desire to participate in DOD business at the subcontractor level. Please take a few minutes of your time to give us your honest answers to these survey questions. You may remain anonymous if you wish. All answers will remain confidential and will only be used for research analysis. Please circle one answer per question which best describes your situation or answer in the space provided. Thank you for your assistance.

This introduction was designed to emphasize the purpose and confidentiality of the survey and to instruct the respondent to choose one best answer to each appropriate question.

The survey questions are presented below along with the rationale for asking each of them. Questions one and two required subjective, narrative responses. Question one was asked to verify that the respondent was from the nonferrous foundry industry. Question two was asked in order to obtain examples of the commercial and DOD uses of an individual foundry's cast products. Question two was also asked to

gauge the awareness of individual foundries to the DOD uses of their products. Questions one and two were:

1. Please briefly describe your primary cast products:
2. Please describe the commercial and/or DOD uses for your primary cast products: (if known)

Question three tried to determine whether or not the respondent knew what its Standard Industrial Classification code (SIC) was. This was asked because numerous databases are organized around individual SICs.

3. My primary Standard Industrial Classification code (SIC) is:

Questions four through eight were designed to collect basic demographic information about the survey respondents. This information was intended to test some of the assumptions made by the researcher concerning the "small business" nature of the foundry industry.

4. What casting process do you primarily use?
5. What metal/alloy type do you primarily cast with?
6. Please indicate your approximate number of employees.
7. Is your company affiliated through ownership with other companies?
8. If you answered yes to question 7, please indicate the total employment of your company and your affiliated companies.

Question nine was the first of two occasions the survey respondent would have to describe his foundry business as primarily subcontract work for other contractors. A response of one or two (exclusively or primarily jobbing)

was interpreted by the researcher to mean that the respondent was primarily a subcontractor.

9. Which of the following best describes your foundry business?

Question ten was a second attempt to gauge awareness of the potential DOD uses of a particular foundry's cast products. It was also asked to facilitate data analysis based on discriminating between foundries that have specific, known DOD uses for their products and foundries that do not.

10. If you answered #1 or #2 in question 9, are the firms you sell to/subcontract with involved in Department of Defense business?

Questions 11 and 12 were designed to obtain sales data on the survey respondent and to further test the researcher's assumptions concerning the "small business" nature of the foundry industry.

11. What percentage of your sales go to? (area)
12. What is the approximate total annual sales volume of your company?

Question 13 was the first filter used in the survey. This filter was used to discriminate between prime contractors and subcontractors based on the researcher's "50% or more of total sales...." criterion. It was also the second time a foundry could identify itself as acting primarily as a subcontractor in its industry. This filter was designed to complement question nine and was expected to reduce the number of respondents continuing with the survey. The filter was considered essential to test the researcher's

assumptions and to target the desired research population of lower tier subcontractors.

13. Do 50% or more of your total annual sales result from subcontract work?

1. Yes

2. No

IF YOU ANSWERED NO TO QUESTION 13, PLEASE STOP AND RETURN THIS SURVEY USING THE ENVELOPE PROVIDED. THANK YOU FOR YOUR TIME AND EFFORT.

IF YOU ANSWERED YES TO QUESTION 13, PLEASE CONTINUE THE SURVEY.

The following definition was provided in the survey for the subcontractors that passed the first filter:

DEFINITION: In this study "Defense" procurement, business and contracting all refer to sales of materials or services to the Department of Defense. These sales may be direct to the government, while acting as a prime contractor for the Department of Defense, or indirect, when a subcontractor sells to a prime contractor who is doing business with the government.

The following instructions were then given concerning a second filter:

Using the above definition of defense business, please consider the following statements concerning DOD business:

#1. I currently participate in DOD business but intend to get out of it.

#2. I currently do not have any DOD business and intend to stay out of it.

14. Do either of the above statements describe your attitude concerning DOD business?

1. Yes

2. No

IF YOU ANSWERED NO TO QUESTION 14, PLEASE STOP AND RETURN THIS SURVEY USING THE ENVELOPE PROVIDED. THANK YOU FOR

TIME AND EFFORT. IF YOU ANSWERED YES TO QUESTION 14, PLEASE CONTINUE THE SURVEY.

This second, critical filter was designed to specifically focus on those subcontractors who refuse, or intend to refuse, DOD business. The survey population remaining after these two filters would provide the data to answer the primary and subsidiary research questions using the remaining survey questions.

Question 15 was designed to discriminate between two hypothetical subcontractor foundry populations: those foundries that never accepted DOD business, or used to in the past but do not now, and those foundries currently in DOD business, but intending to get out. The responses obtained from this question would provide a wealth of non-probabilistic data on the attitudes and business intentions of foundries out of or exiting the DIB.

15. Which of the statements listed above concerning DOD business best describes your situation?

1. I'm IN DOD business but intend to GET OUT

2. I'm OUT of DOD business and intend to STAY OUT.

In order to discriminate further between the get out and stay out populations, the following questions were asked to obtain more data on the stay out population's previous experiences with DOD business. The following instructions and questions were given/asked:

IF YOU CHOSE ANSWER #1 ABOVE, PLEASE SKIP TO QUESTION 18.
IF YOU CHOSE ANSWER #2 ABOVE, PLEASE CONTINUE.

16. If you do not currently participate in DOD business, which of the following best describes your DOD business experience?
1. We have never tried making sales to the government.
 2. We have tried but never made sales to the government.
 3. We have made such sales in the past but do not now.
17. If you were involved in DOD business in the past but are not now, how long ago were you involved in DOD business?

The rest of the survey dealt specifically with the reasons a subcontractor foundry had for refusing or intending to refuse to participate in DOD business. Twenty-two specific reasons gleaned from the available research literature were provided for the respondent to review and scale for importance. An "other" response was also provided to capture unique/unforeseen reasons. The respondent was instructed to answer each question. This was done in conjunction with a response scale to facilitate data analysis focusing on the relative and absolute importance of each reason to the respondent. The following instructions were provided:

Please carefully review all of the following reasons for not participating in DOD business. After reviewing all of the reasons, please indicate the importance of each reason to your decision to get out of DOD business or to stay out of DOD business. Please use the following response scale for each question:

- 1 = not important at all to my decision
- 2 = somewhat important to my decision
- 3 = important to my decision

4 = very important to my decision

5 = the most important reason for my decision.

My/our company does not participate in, or intends to stop participating in, DOD business because of:

18. prime contractor late payment or non-payment of bills.
19. burdensome paperwork requirements.
20. prime contractor contract flow-down requirements.
21. adversarial government/prime contractor relationships.
22. adversarial prime/sub contractor relationships.
23. uncertainty/instability of government business base.
24. low profitability/lost money on government related subcontracts.
25. prime contractor/higher level subcontractor contracting methods/policies on DOD related business.
26. we don't know how to obtain government subcontracts.
27. government/prime contractor auditing requirements/procedures.
28. inconsistent quality requirements.
29. overly restrictive (too high) quality standards.
30. acceptance/rejection problems with my product.
31. inflexible government procurement methods/policies.
32. delays in making awards/frequent contract changes.
33. inefficient production levels/rates.
34. we have heard too many "horror" stories about DOD business.
35. more attractive commercial sales to non-DOD prime contractors.
36. do not have production capability/capacity to accept government work.

- 37. government will not let me use my normal foreign sources of supply for production materials/requirements.
- 38. lost DOD subcontract business to other competitors.
- 39. previous contract(s) terminated.
- 40. other reason(s).

The last two questions of the survey were designed to help the respondent discriminate between the most important reasons a respondent had for refusing or intending to refuse to participate in DOD business.

- 41. Of all the reasons listed in questions 18 through 40, what is the one reason you consider the most important to your decision to not participate in DOD business? Please explain, perhaps with an example, the specifics of your choice.

Question 41 attempted this by asking the respondent to choose and subjectively describe a single most important reason for his decision to not participate in DOD business. This was done to discriminate between multiple responses of five on the reasons provided. Question 42 was designed to approach this discrimination process from the opposite perspective: what conditions would have to change in order to motivate the subcontractor to stay in or get into, DOD business. It was assumed by the researcher that the answers to questions 41 and 42 would focus on similar reasons/concerns. By asking both questions, the researcher hoped a broader perspective would be obtained on the most important reasons/motivations of these foundry subcontractors

refusing, or intending to refuse, to participate in DOD business.

42. Under what conditions would you consider getting into DOD business or staying in DOD business? Please comment:

Even though the survey was conducted on a strictly confidential basis to encourage candid answers and to increase the return rate, an opportunity was provided for the respondent to identify himself and indicate if he was willing to be interviewed.

43. I am willing to discuss my views by:

a. phone:	yes	no
b. personal interview:	yes	no

44. (OPTIONAL):

Name: _____

Company: _____

Address: _____

Phone: (_____) _____

D. SUMMARY

This chapter has provided an in-depth overview of the background, methodology and development of the survey questionnaire used. The rationale for each question used was presented. Chapter IV will present and analyze the data generated by the survey.

IV. AN ANALYSIS OF WHY FOUNDRIES REFUSE DOD BUSINESS

A. INTRODUCTION

The previous chapter introduced the reader to the survey objectives and methodology. This chapter presents the data that was obtained from the survey and analyzes the reasons why nonferrous foundry subcontractors refuse to participate in DOD business. Various subsets of the survey population are studied and the results of hypothesis tests are presented. The chapter concludes with a presentation of the most significant reasons foundry subcontractors have for not participating in DOD business.

B. ANALYSIS OF THE SURVEY RESPONSES

Of the 244 survey responses received and analyzed, three distinct populations subsets appeared in the data as a result of the survey filters used. The first and largest of these three subsets consisted of 123 firms (50%) which represented firms that did not identify themselves as subcontractors (answered no to question 13). The next subset consisted of 73 firms (30%) which represented firms identifying themselves as subcontractors that intended to participate in DOD business (answered yes to question 13 and no to question 14). The final subset consisted of 48 firms (20%) which represented subcontractors who refuse, or intend to refuse, to participate in DOD business (answered yes to

yes to question 13 and yes to question 14). A graphical representation of this survey universe is presented in Figure 4-1. The data analysis that follows begins with a demographic analysis of the entire survey universe and then focuses on an analysis of the refusal reasons of the 48 firms which passed both filters. The data analysis concludes with explanatory factor hypothesis tests.

1. Demographic Analysis

Questions one and two asked the respondent to describe his cast products and their known uses. Cast product descriptions and uses were provided by all the respondents and ranged from plumbing fixtures to castings used in the NASA space shuttle. Numerous DOD cast products were described and included parts for combat aircraft, tank and armored vehicles, submarines and ships. Virtually all of these products were used as piece parts or components in larger assemblies integrated by larger prime contractors.

Question three asked for the Standard Industrial Classification code (SIC) of the firm. This question was left blank, or incorrectly filled in by the vast majority of the survey respondents. This supported a common observation that most commercial firms do not know their SIC is (or for that matter, appear to care).

Questions four and five asked for information concerning the casting process and the metal/alloy type used. Figures 4-2 and 4-3 graphically illustrate the survey

SURVEY POPULATION

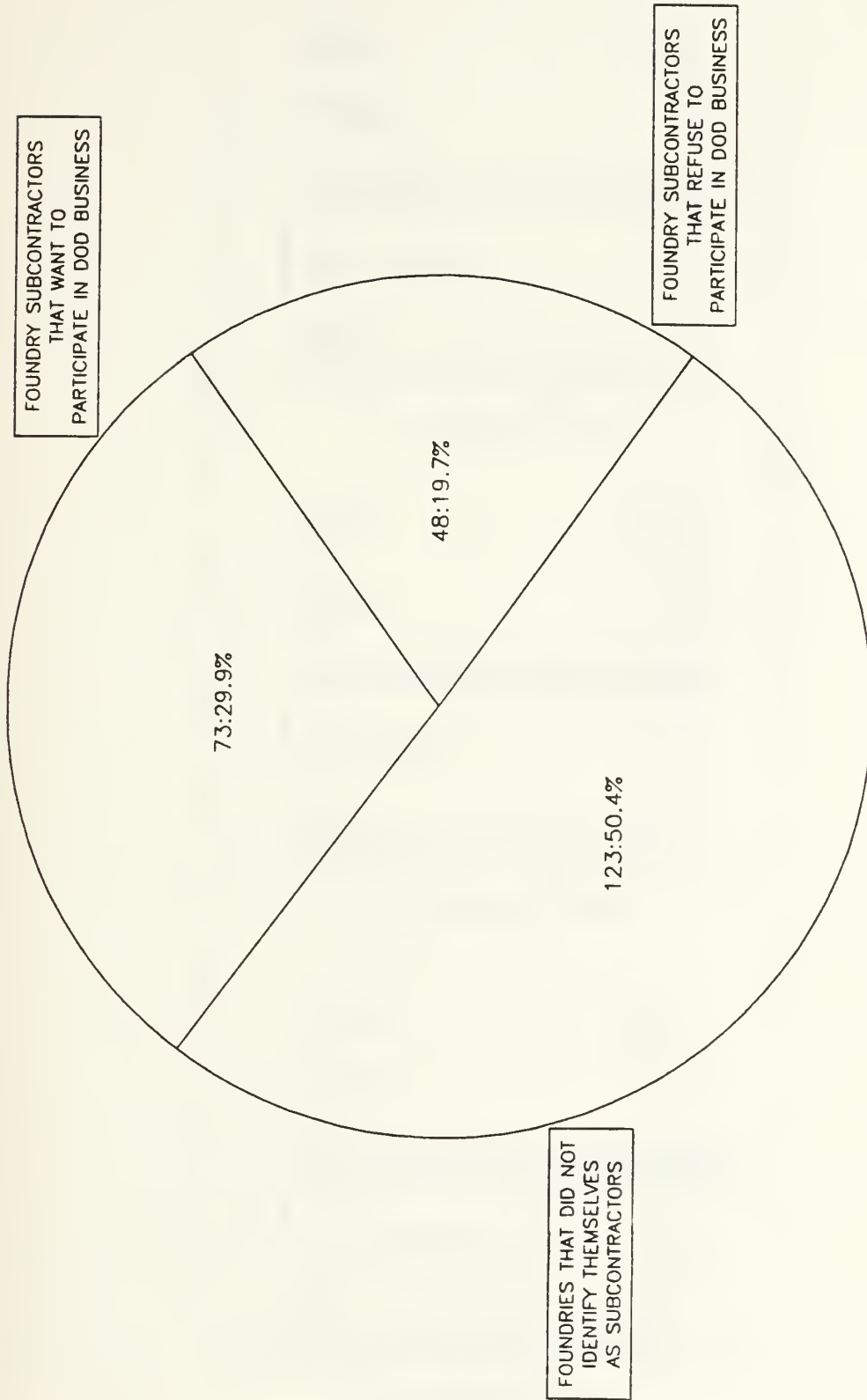


Figure 4-1 SURVEY POPULATION SUBSETS

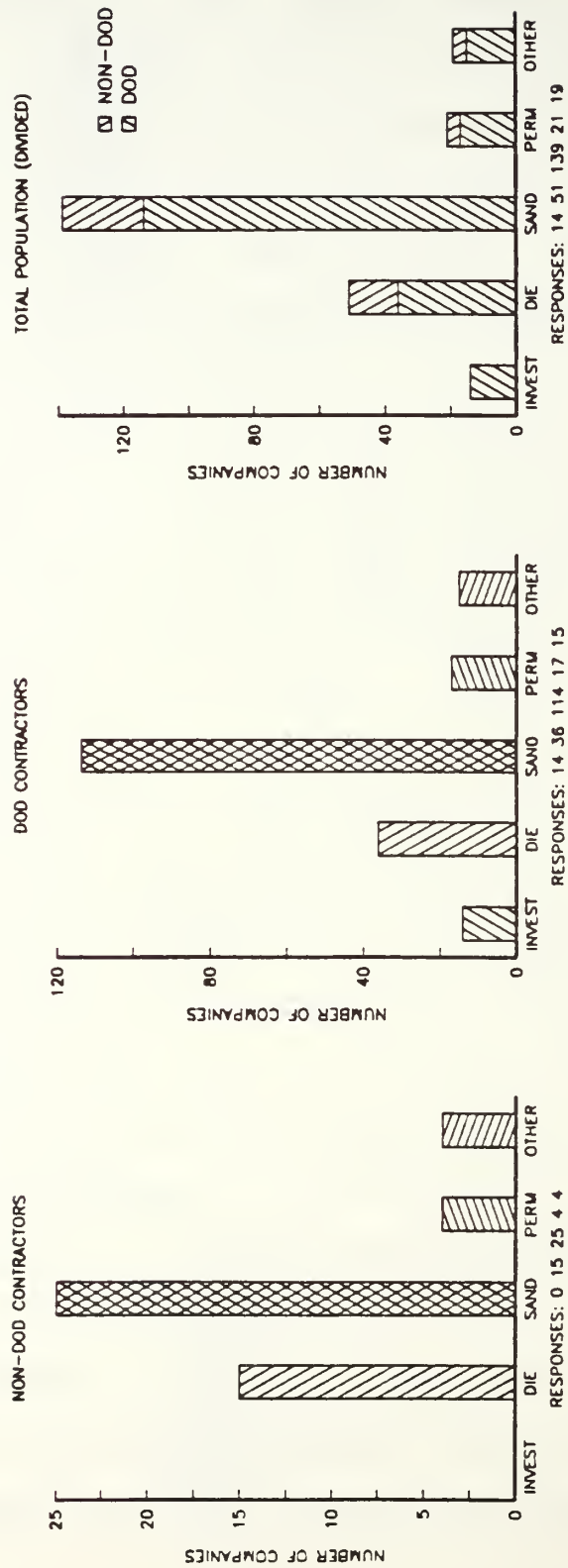


Figure 4-2 CASTING PROCESS USED - QUESTION 4

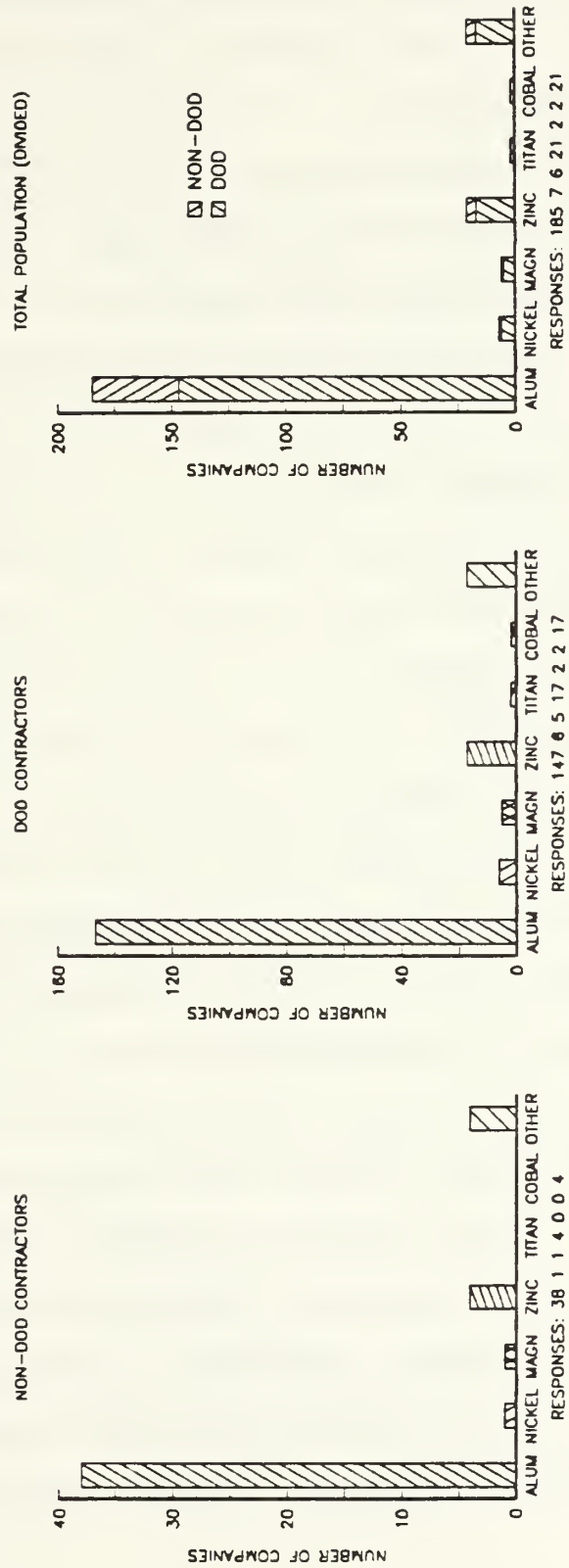


Figure 4-3 METAL/ALLOY TYPE USED - QUESTION 5

responses to these two questions. In Figure 4-2 the following casting process choices were used:

1. investment casting (invest),
2. die casting (die),
3. sand casting (sand),
4. permanent mold casting (perm), and
5. other castings processes (other).

In Figure 4-3 the following metal/alloy type choices were used:

1. aluminum alloys (alum),
2. nickel based alloys (nickel),
3. magnesium alloys (magn),
4. zinc alloys (zinc),
5. titanium (titan),
6. cobalt (cobal), and
7. other alloys (other).

The survey responses are separated into "NON-DOD," "DOD" and "TOTAL" groups. These groups correspond to NON-DOD contractors that passed both survey filters (NON-DOD = do not want to participate in DOD business), DOD contractors that did not pass both filters (DOD = want to participate in DOD business), and all survey respondents (TOTAL POPULATION = DOD + NON-DOD). Inspection of these data indicated that sand and die casting processes using aluminum were overwhelming used by both NON-DOD and DOD contractors. This was expected by the researcher because sand casting is the

most commonly used casting process for cost and technical reasons and aluminum is the most widely used "white" metal in nonferrous foundries.

Question six asked for the approximate number of employees. Figure 4-4 illustrates the survey responses using the same DOD and NON-DOD groupings previously described. The survey respondents are overwhelmingly small businesses employing 500 or fewer employees. As previously discussed, the Federal Acquisition Regulations (FAR) defined a small business in the foundry industry as a foundry employing 500 persons or less. These survey data supported the researcher's assumption that a majority of the nonferrous foundries would be small businesses. Looking at the data presented in Figure 4-4 it appeared that DOD contractors are slightly larger than NON-DOD contractors but were still overwhelmingly small businesses.

Questions seven and eight asked if the survey respondent was affiliated through ownership with other companies and, if so, what was their total employment. Approximately 75% of both the NON-DOD and DOD respondents were not affiliated through ownership with other companies. Of the remaining 25% that were affiliated, more than half were still small businesses based on employment figures. Figure 4-5 illustrates these combined data.

Question nine asked the survey respondent to describe his foundry business in terms of who used the cast

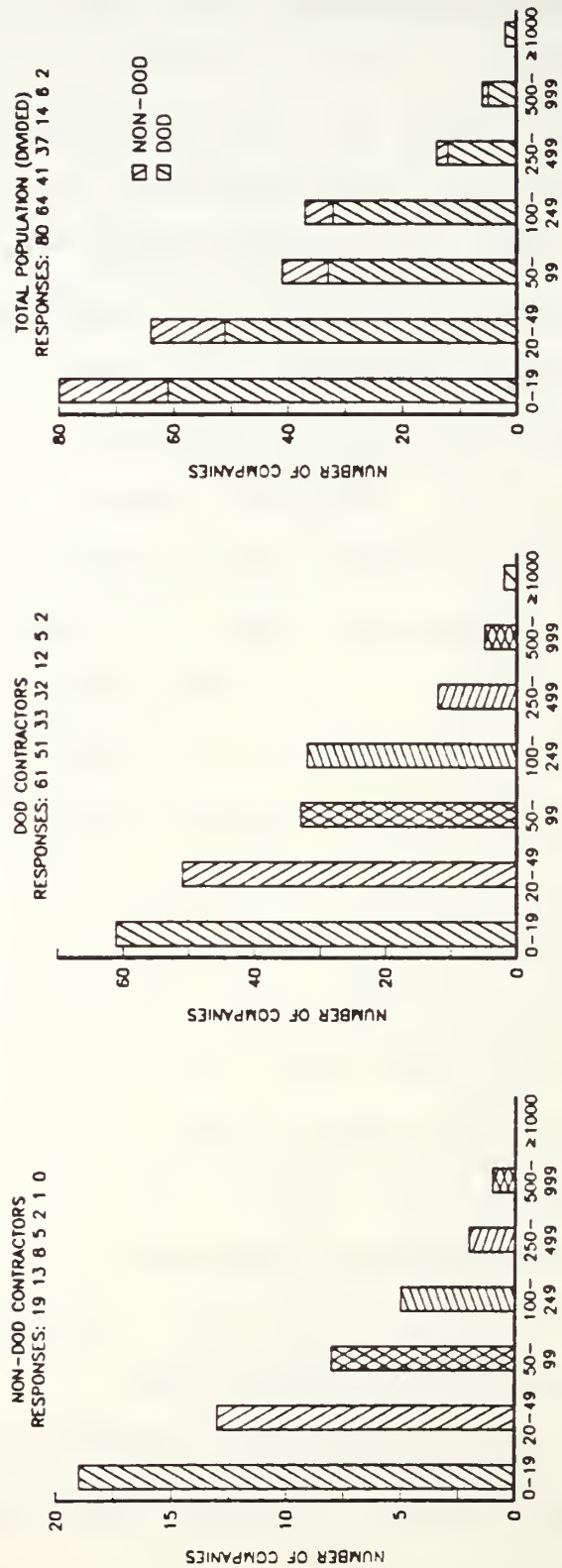


Figure 4-4 NUMBER OF EMPLOYEES - QUESTION 6

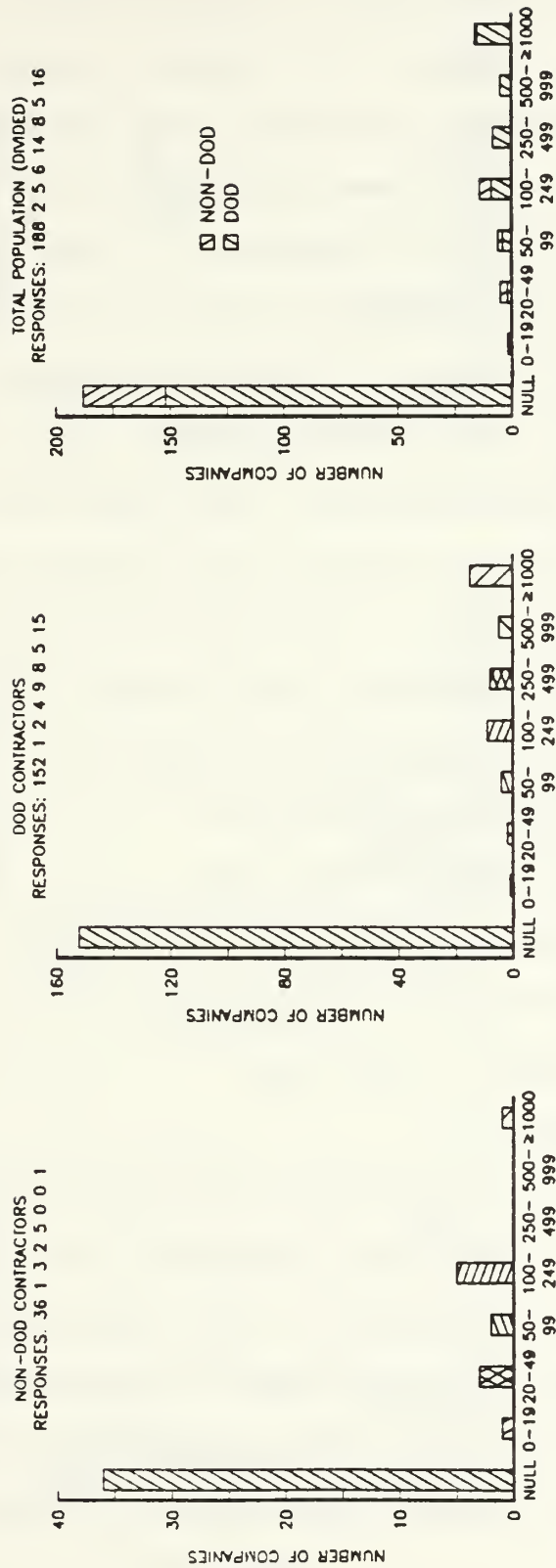


Figure 4-5 EMPLOYMENT INCLUDING AFFILIATED COMPANIES - QUESTIONS 7 AND 8

products produced. This question was asked in order to allow the survey respondent to characterize his business as either a jobbing foundry or a captive foundry. A jobbing foundry was previously described as a subcontract producer while a captive foundry was described as a prime contract producer. The survey responses to this question were important due to this self-characterization process. One of the requirements for the research population was that the individual firms within that research population identify themselves as subcontractors. The researcher also assumed that a majority of the firms in the foundry industry would be subcontractors due to the nature of the products they produce and their relatively small sizes. The responses to question nine are illustrated in Figure 4-6. The Figure 4-6 self-characterization choices were:

1. exclusively jobbing (all job)
2. primarily jobbing (pri job)
3. exclusively captive (all cap)
4. primarily captive (pri cap)
5. other (other).

As the reader can see, the vast majority of both NON-DOD and DOD contractors identified themselves as exclusively or primarily jobbing foundries. The researcher interpreted this to mean that they are primarily subcontractors.

Question 10 asked survey respondents that identified themselves as exclusively or primarily jobbing foundries,

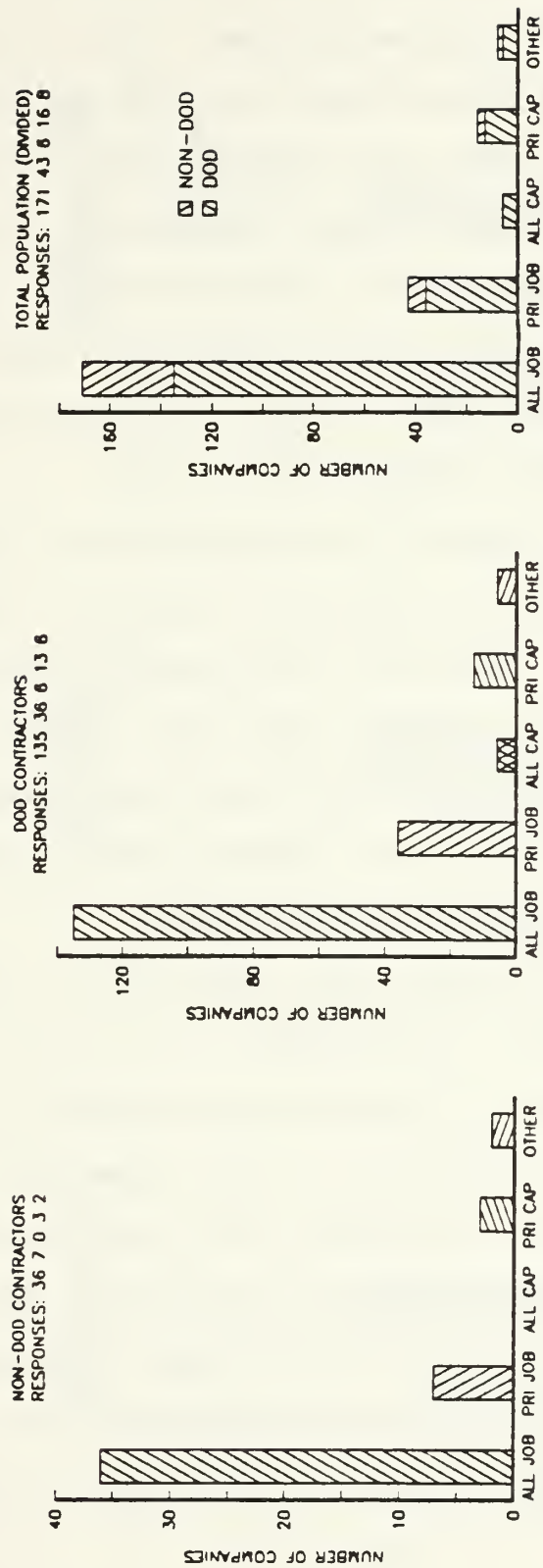


Figure 4-6 TYPE OF FOUNDRY BUSINESS -- QUESTION 9

whether or not they knew if the firms they sold to/subcontract with were involved in DOD business. Sixty-three percent of the DOD contractors and 77% of the NON-DOD contractors indicated the firms they sold to were involved in DOD business. These data suggest that the majority of NON-DOD foundries (foundries that do not want to participate in DOD business) produce cast products which could be/are used by DOD prime contractors in military weapon systems. Refusal of these particular firms to participate in DOD business is therefore even more significant.

Question 11 asked the respondent to describe the majority of his sales by geographic location. Both NON-DOD and DOD contractors conducted the majority of their sales with local customers (within 100 mile radius) with less significant sales to regional and national customers. Only DOD contractors reported any foreign (OUTUS) sales. Figure 4-7 depicts these data.

Question 12 asked for approximate total annual sales. This question was included in order to complement the earlier question on business size based on number of employees. It was assumed by the researcher that the majority of foundries surveyed would have relatively low total annual sales figures due to the small size of these businesses. The data presented in Figure 4-8 support these assumptions with the majority of both NON-DOD and DOD firms reporting \$10 million or less in total annual sales. These

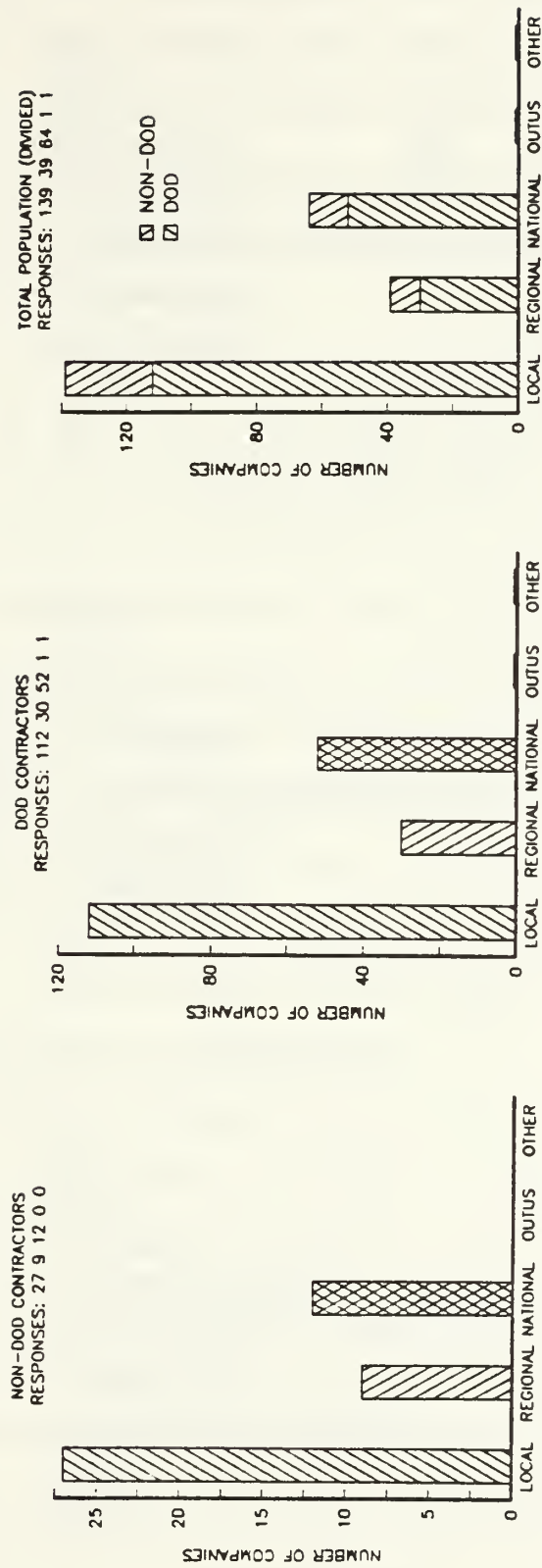


Figure 4-7 LOCATION OF SALES -- QUESTION 11

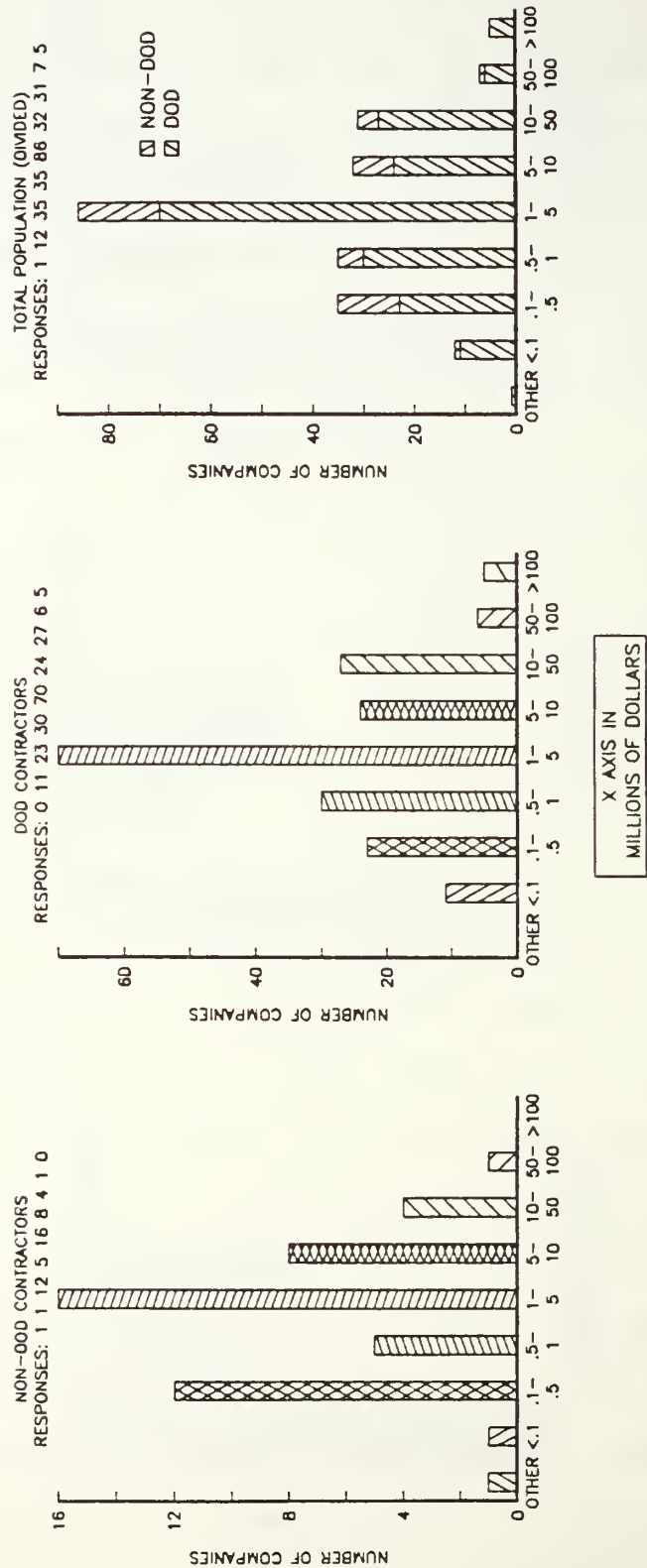


Figure 4-8 TOTAL ANNUAL SALES - QUESTION 12

data are important because, along with employee size and company affiliation, they suggest that the extremely small "mom and pop" type foundry may exist more in fact than fiction. They also suggest that the vast majority of these firms, due to their size, may not have the capital resources to invest in the capacity and technology required to make sophisticated DOD castings.

All 244 survey respondents answered (where appropriate) these first 12 survey questions. As stated previously, these questions were designed to provide basic demographic data on the survey respondents and to test some of the researcher's basic assumptions about the foundry industry. Questions 13 and 14 contained the two previously mentioned filters designed to identify subcontractors that refuse, or intend to refuse, to participate in DOD business. An analysis of the reasons why this group of foundry subcontractors have this attitude about DOD business follows.

2. Refusal Reason Analysis

This chapter segment analyzes the survey responses to questions 15 through 42. These questions followed the two survey filters and therefore were answered only by subcontractors who refuse, or intend to refuse, to participate in DOD business. The survey data provided by this population formed the basis for answering the primary and subsidiary research questions in Chapter V. Of the 244

returned surveys, 48 passed both filters. The first filter, question 13 asked: "Do fifty percent or more of your total annual sales result from subcontract work?" If the answer was yes, the respondent continued to question 14, which was the second filter. Question 14 asked the respondent if either of the following statements described his attitude concerning DOD business?

- #1. I currently participate in DOD business but intend to get out of it.
- #2. I currently do not have any DOD business and intend to stay out of it.

If the answer to question 14 was also yes (having passed both filters), the respondent would then go on to complete the remaining 26 survey questions dealing with the reasons why the firm refused, or intended to refuse, to participate in DOD business.

As stated in the introduction to this chapter, the 48 survey respondents which passed both filters represented 20% of the returned surveys. Seventy three respondents (30%) passed the first filter but not the second, and the 123 remaining respondents (70%) did not pass either filter.

Question 15 asked the 48 respondents which of the attitudes in question 14 best described their situation. Twenty one foundries (44%) indicated that choice #1 (GET OUT) best described their situation while the other 27 foundries (56%) indicated that choice #2 (STAY OUT) best described their situation.

Question 16 asked the 27 STAY OUT respondents to describe their previous DOD business experience (if any). Eight firms indicated they had never tried making sales to DOD, eight firms indicated they had tried but never succeeded in making sales to DOD, and the remaining 11 indicated they had made sales to DOD in the past.

Question 17 asked the STAY OUT respondents from question 16 that had previous sales to DOD (11 firms) but did not now, how long ago they sold to DOD. Eight firms indicated that they had made sales to DOD two or more years ago with the remaining three firms having made such sales within the last two years.

Questions 18 through 39 asked the respondent to review and scale for importance, 22 different reasons for not participating in DOD business. These 22 refusal reasons and one optional "other" reason are the heart of the survey and this research effort. Each potential reason for the decision to refuse to participate in DOD business was required to be ranked for importance according to the following scale:

1. not important at all to my decision,
2. somewhat important to my decision,
3. important to my decision,
4. very important to my decision,
5. the most important reason for my decision.

By asking the respondent to use this scale on every reason, the researcher hoped each survey respondent that passed both filters would carefully review and clearly discriminate between the relative importance of the various hypothesized reasons for refusing to participate in DOD business.

Before analyzing the overall responses to the 22 "standard" reasons provided in the survey, the researcher wanted to determine how discriminating each of the 48 firms which passed both filters had been in scaling the 22 "standard" reasons. It was assumed that the fewer number of times that an individual firm used response five, or responses four and five (the strongest responses), the greater the discrimination on the part of the firm between more important reasons and less important reasons for not participating in DOD business. Figures 4-9 and 4-10 present an analysis of the number of times each of the 48 firms used these responses along with a "mean response value."

Figure 4-9 represents the response distribution for response five. The reader should note that seven firms did not use response five at all, and one firm used response five for all 22 reasons for not participating in DOD business. Figure 4-10 represents the response distribution for responses four and five. The reader should note that only one firm did not use either response four or five on any of the 22 questions. Both these figures graphically illustrate two survey population subsets. The first subset

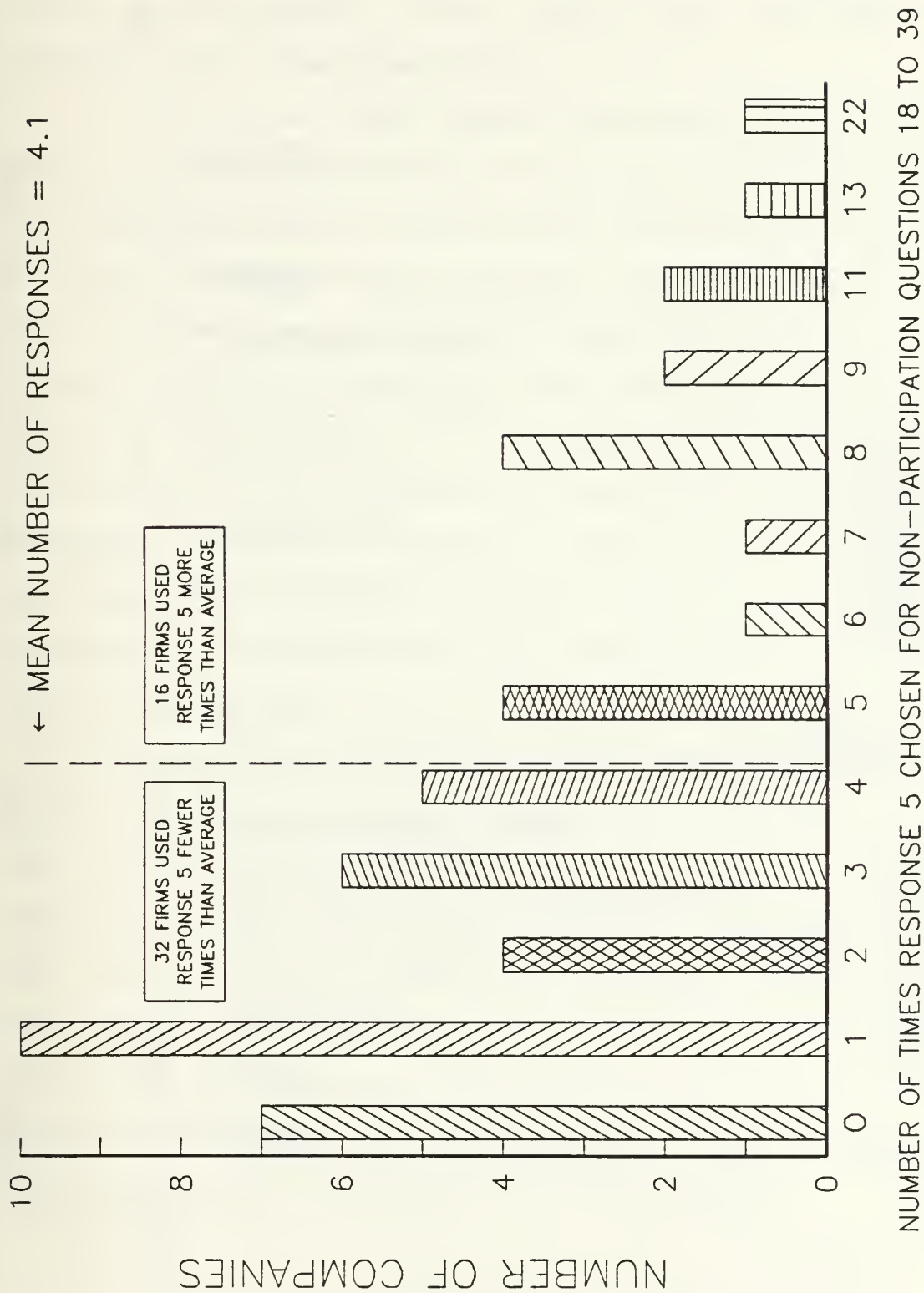


Figure 4-9 ANALYSIS OF RESPONSE 5

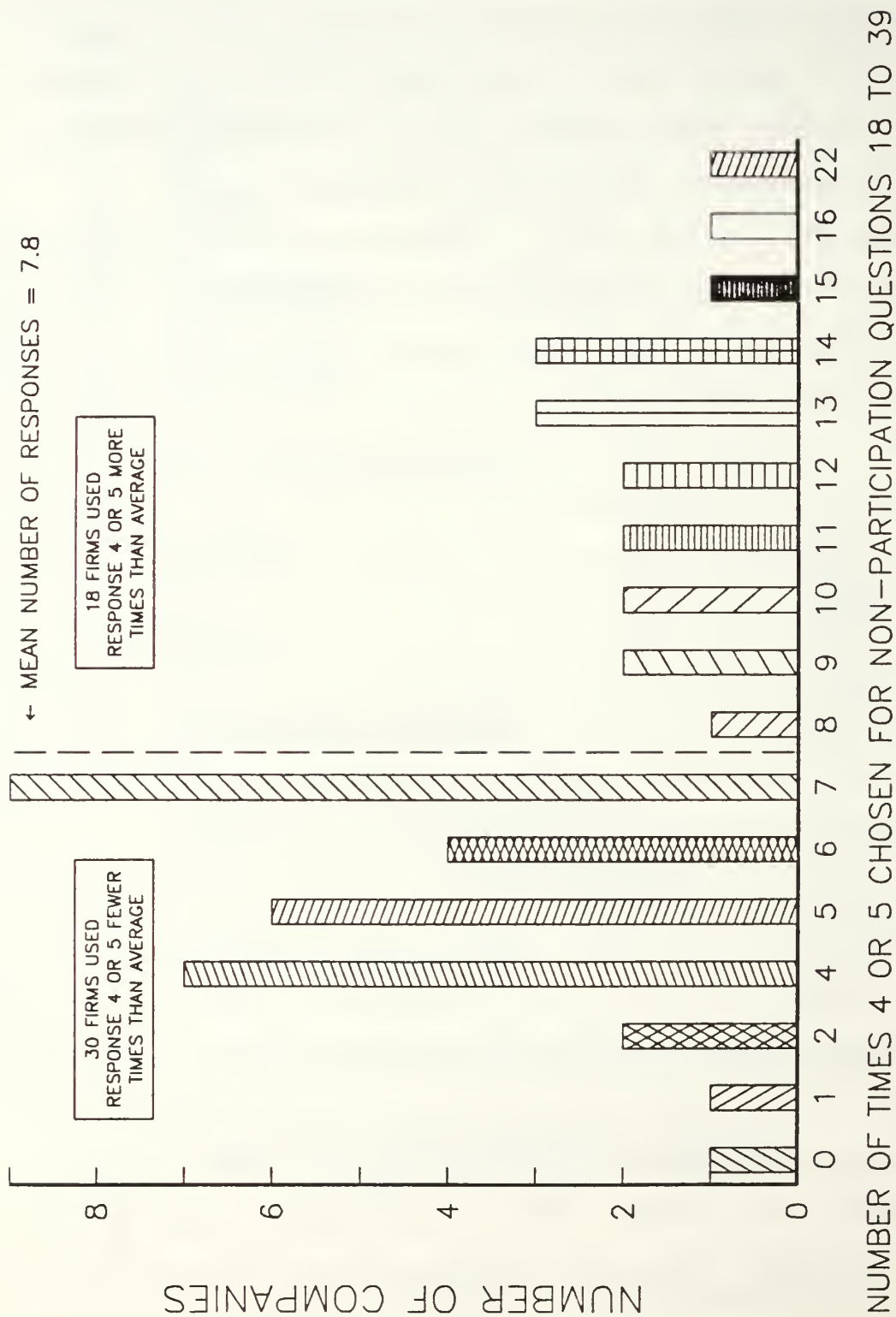


Figure 4-10 ANALYSIS OF RESPONSE 4 OR 5

consists of more discriminating firms which used these "stronger" responses fewer times than the average, and those less discriminating firms which used the "stronger" responses more times than average.

In both of these figures the data suggest that the majority of the respondents followed the survey instructions and strongly discriminated between the relative importance of each of the 22 refusal reasons. Thirty-two firms (67%) used response five, four or fewer times while scaling all 22 reasons. Thirty firms (63%) used responses four or five, seven or fewer times while scaling all 22 reasons. Upon initial review, the researcher thought that comparing the responses for all 48 firms to the 32 firms that used response five fewer times than the average would be beneficial in highlighting the differences in attitudes between a less discriminating (all 48 firms) group and the more discriminating (32 firms) group. However, using this highly discriminating group of 32 firms causes the loss of data observations for seven firms that did not choose response five for any of the 22 reasons. Therefore, in the data analysis that follows, the researcher decided to use and compare the responses from both a 48 firm (less discriminating) group and the 30 firm (more discriminating) group to highlight the differences in their respective attitudes towards participating in DOD business.

A statistical analysis was performed using GRAFSTAT on each of the 22 reasons and the responses received by it. This analysis included frequency histograms, box and whisker plots and basic descriptive statistics. These frequency histograms and basic descriptive statistics for each of the 22 reasons are included in Appendix C. After analyzing the descriptive statistics and graphical output, the researcher concluded that response mean of three or greater for any individual refusal reason was statistically significant.

Figure 4-11 graphically displays the overall (48 firms) response means for each of the 22 refusal reasons in the form of skyscraper plots. Those plots rising above the reference line had means of three or greater and median response values of four. In the researcher's opinion they represented the most statistically significant reasons for refusing, or intending to refuse, to participate in DOD business in this study.

The seven most significant reasons ranked in order of most to least importance are:

- #31 inflexible government procurement methods/policies
- #19 burdensome paperwork requirements
- #35 more attractive commercial sales to non-DOD prime contractors
- #29 overly restrictive (too high) quality standards
- #28 inconsistent quality requirements
- #24 low profitability/lost money on government related subcontracts

MEAN RESPONSES FOR 48 COMPANIES TO QUESTIONS 18 TO 39 BY NON-DOD CONTRACTORS

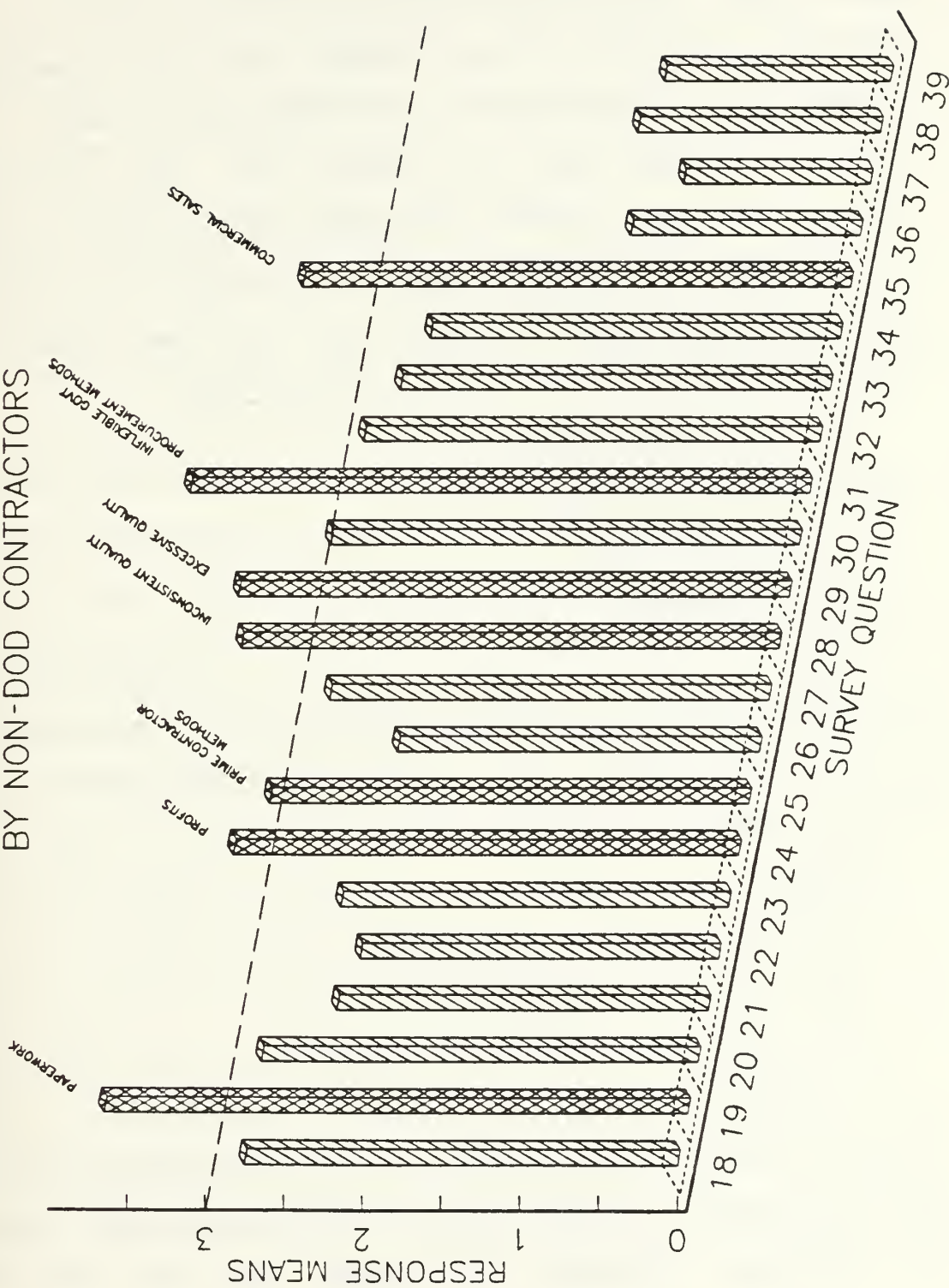


Figure 4-11 REASONS FOR NOT PARTICIPATING IN DOD BUSINESS

- #25 prime contractor/higher level subcontractor contracting methods/policies on DOD related business.

Figure 4-11 displays a wealth of data which tends to confirm some of the hypothesized reasons for contractor unwillingness to participate in DOD business that was presented in Chapter II. These data also substantiate some of the earlier findings from the Gaffney and Lamm studies on business attitudes towards participating in DOD business.

Chapter II presented research findings from Gaffney's masters thesis that indicated the top five reasons for refusing to participate in DOD business were:

- Too hard/complicated
- Government bidding methods
- Low profitability
- Not interested
- Other.

The researcher also presented Lamm's study which indicated the top five reasons for refusing to participate in DOD business were:

- Burdensome paperwork
- Government bidding methods
- Inflexible bidding methods
- More attractive commercial ventures
- Low profitability.

If the Gaffney survey reason of "Too hard/complicated" can be interpreted as referring to complex procurement policies or difficult paperwork requirements, then the top three

Gaffney survey reasons and all of the top five Lamm survey reasons are substantiated by these survey results.

Also of importance in Figure 4-11 are those reasons that stand out as not important to the decision to refuse to participate in DOD business. The seven least significant reasons for not participating in DOD business ranked in order of least to most importance were:

- #37--Government will not let me use my normal foreign sources of supply for production materials/requirements
- #36--Do not have the production capability/capacity to accept Government work
- #39--Previous contract(s) terminated
- #38--Lost DOD subcontract business to other competitors
- #22--Adversarial prime/sub contractor relationship
- #26--Don't know how to obtain Government subcontracts
- #21--Adversarial Government/prime contractor relationship.

The researcher was not surprised by the most significant reasons for not participating in DOD business but was surprised by some of the least significant reasons. Production capacity/capability was assumed by the researcher to be a significant problem for nonferrous foundry subcontractors. This was assumed because of the historically high capacity utilization in the industry (well over 70% as discussed in Chapter II) and the extremely high quality requirements for DOD castings. The survey respondents may have indirectly addressed these issues when they indicated that more attractive commercial ventures and

overly restrictive quality were among the top four reasons for not participating in DOD business. It was also assumed that intense price competition at the subcontractor level was forcing many of these foundries to drop out of the DOD marketplace. However, reason 38, "lost DOD subcontracts business to other competitors," did not appear to be a significant non participation reason. Chapter II hypothesized that an adversarial prime/sub contractor relationship and the prime's ability to shift risk with negative contract flow down clauses was forcing subcontractors out of the Defense Industrial Base (DIB). Reason 22, "adversarial prime/sub relationships," and reason 39, "previous contract(s) terminated," were used to test this hypothesis. Both reasons did not appear to be significant from the results of this study. Finally, numerous informal comments were received by the researcher that small businesses do not know how to obtain DOD contracts. Reason 26, "we don't know how to obtain Government subcontracts," was included in the survey to gauge the extent of this problem. Again, this reason did not appear to be significant to the decision not to participate in DOD business.

Having briefly analyzed the overall responses of all 48 firms, the researcher then compared two subsets of this population against each other. It was felt that a better discrimination between the relative importance of the

various reasons for not participating in DOD business would be obtained from those firms that used the two strongest responses (four or five) fewer times than the overall average. As discussed earlier, responses four or five were used an average of 7.8 times by all 48 firms. Figure 4-12 illustrates the response differences between these two population subsets: those firms that used response four or five less than 7.8 times (more discriminating) and those firms that used response four or five more than 7.8 times (less discriminating). The reader should note that the Y axis is no longer a response mean but the number of four or five responses. Thirty firms fell into the more discriminating category and the remaining 18 into the less discriminating category. As expected, the more discriminating 30 firms showed greater variability in their responses than the less discriminating firms. These firms clearly indicated that reasons 19, 31 and 35 (procurement policy, commercial sales and paperwork) were significant factors in their decisions not to participate in DOD business.

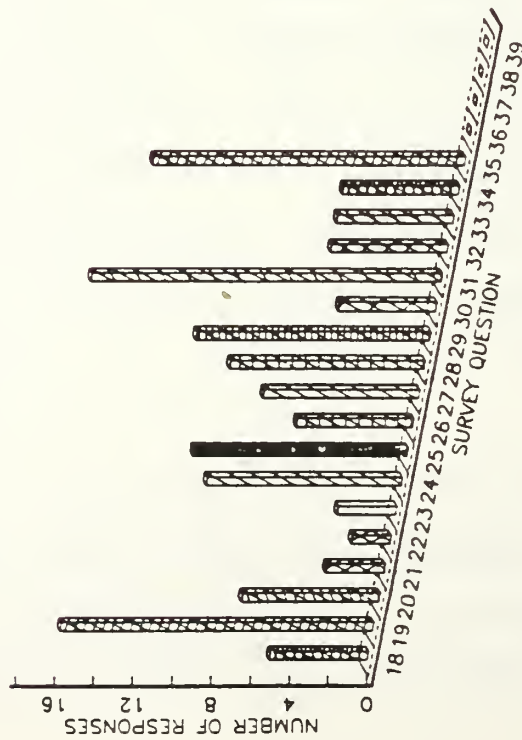
Question 15 asked each survey respondent to describe his attitude towards DOD business as either of the following:

#1--I'm IN DOD business but intend to GET OUT

#2--I'm OUT of DOD business and intend to STAY OUT.

This created two population subsets among the 48 firms that passed both survey filters: the GET OUT subcontractors and

30 MORE DISCRIMINATING COMPANIES



18 LESS DISCRIMINATING COMPANIES

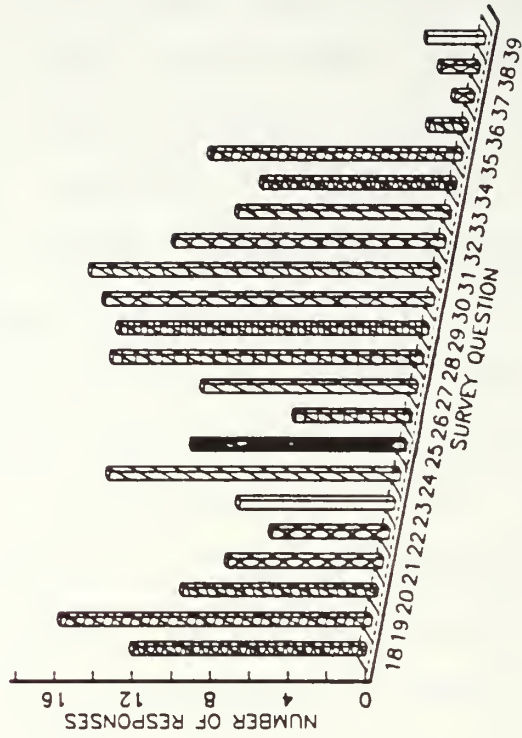
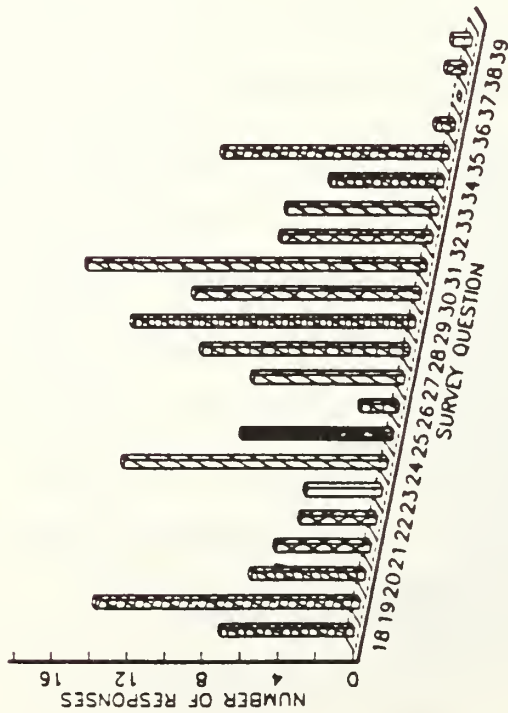


Figure 4-12 ANALYSIS OF RESPONSES 4 AND 5

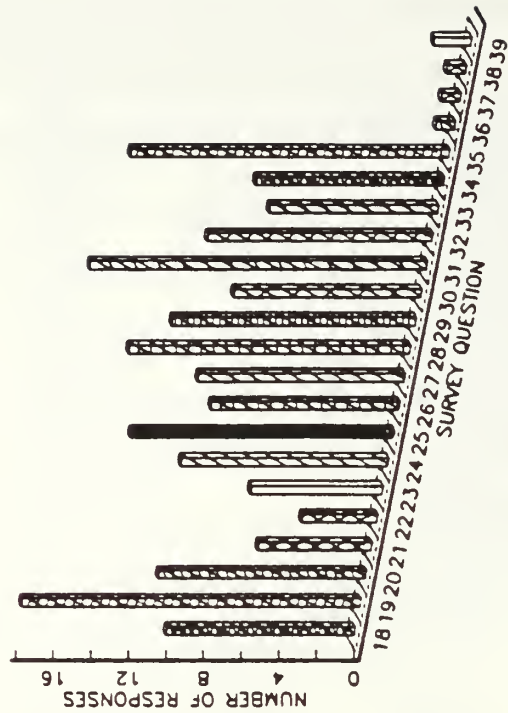
the STAY OUT subcontractors. The researcher then tried to determine if there were any significant differences between GET OUT and STAY OUT subcontractor reasons for not participating in DOD business. Using responses four and five only, Figure 4-13 compares the GET OUT and STAY OUT subcontractor responses to the responses for all 48 firms. These data indicate 21 firms (44%) intend to GET OUT of DOD business and 27 firms (56%) intend to STAY OUT of DOD business.

These GET OUT and STAY OUT distinctions are important because they represent the differences between the DOD business experiences/attitudes of these two groups of subcontractors. The GET OUT group is involved with DOD business now and intends to not participate in the future. The most significant reasons chosen by this group for not participating in DOD business represent the reality of their experiences in today's DOD marketplace. The most significant reasons chosen by the STAY OUT group for not participating in future DOD business represent their perception of what today's DOD marketplace would be like to work in. The researcher believes that these perceptions have probably been shaped more by opinion and impression than recent actual experience. This observation was based on the analysis of responses to question 16 where the majority (16 of 27) of the STAY OUT firms indicated they had never successfully made sales to the Government.

21 COMPANIES WHO INTEND TO GET OUT



27 COMPANIES WHO INTEND TO STAY OUT



RESPONSES 4 AND 5 FROM 48 COMPANIES

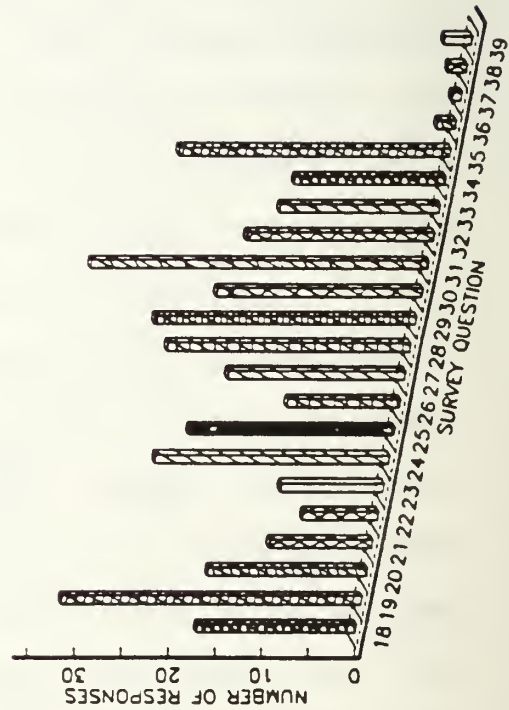


Figure 4-13 COMPARISON OF RESPONSES 4 AND 5 FOR GET OUT AND STAY OUT COMPANIES

Figure 4-13 provides interesting insights to these experiential and perceptual differences between STAY OUT and GET OUT subcontractor reasons for not participating in DOD business. The five most significant reasons GET OUT subcontractors have for not wanting to participate in DOD business were (listed in order of most to least importance):

- #31--Inflexible Government procurement methods/policies
- #29--Overly restrictive (too high) quality standards
- #24--Low profitability/lost money on Government related subcontracts
- #19--Burdensome paperwork requirements
- #35--More attractive commercial ventures.

The five most significant reasons the STAY OUT subcontractors had for not participating in DOD business were (listed in order of most to least importance):

- #31--Inflexible Government procurement methods/policies
- #19--Burdensome paperwork requirements
- #35--More attractive commercial ventures
- #28--Inconsistent quality requirements
- #25--Prime contractor/higher level subcontractor contracting methods/policies on DOD related business.

Several observations can be made from these data. First, the five most significant reasons for each population subset are different only in one category, reason 29 for the GET OUT subcontractors, and reason 28 for the STAY OUT subcontractors. Significantly, both these reasons are quality related. More importantly, the five most significant

reasons for each population are included in the seven most significant reasons identified for the overall population responses in Figure 4-11.

The similarities and differences in the relative significance of individual reasons for not participating in DOD business also serve to illustrate the experiential and perceptual differences between these two population subsets. The most significant similarity for each group, and for the overall population as well, was the significance of inflexible Government procurement policies as the most important reason for not participating in DOD business. This might suggest that there is little difference between the negative experiences of firms actually involved with DOD business and the negative perceptions of firms not involved in DOD business when trying to decide whether or not to not participate in DOD business.

Important differences between the two groups involve quality, paperwork and more attractive commercial sales reasons. The GET OUT subcontractors ranked overly restrictive (too high) quality as its second most important reason, while the STAY OUT subset ranked overly restrictive quality requirements as its seventh most important reason. This difference could be due to the reality of the GET OUT subcontractors' experiences in producing DOD castings. Overly restrictive quality is another way of expressing the common observation that DOD over specifies the requirements

for most of the products it procures. This is an especially sensitive issue for the foundry industry. Numerous foundries indicated to the researcher that they are often confronted with tolerance specifications that exceed the technical abilities of common casting processes used and have little to do with the actual performance or function of the casting being produced. Inconsistent quality requirements appeared to be much more important to STAY OUT firms than GET OUT firms. The researcher does not know why, other than to suggest that STAY OUT firms that used to be in DOD business were frustrated to the point of leaving the market due to inconsistent quality requirements levied on them by higher level primes.

Burdensome paperwork requirements were much more significant to the STAY OUT subcontractors than to the GET OUT subcontractors. This again could represent a perceptual issue, where those firms not participating in DOD business perceive the amount of burdensome paperwork required in DOD business to be worse than it actually is. GET OUT firms that are actually dealing with "burdensome paperwork" considered it a significant factor, but to a much less extent than the STAY OUT firms. This is an important distinction because burdensome paperwork was continually cited as an example of why firms won't do business with the Government--yet those firms that are doing business with the Government (but intending to GET OUT) didn't rank its

significance as high (fourth vs. second) as those firms already out of the DOD the market. A final important distinction between the two groups was the difference in the relative significance of more attractive commercial sales as a reason for not participating in DOD business. The GET OUT firms ranked this reason fifth while the STAY OUT firms ranked it third. This probably reflects the differences in the amount of commercial experience each of these two groups has had/does have. The STAY OUT firms have already made the decision to pursue only commercial work and therefore would be expected to rank significance of this reason higher. However, it is important to note here, that all groups ranked the significance of more attractive commercial sales highly. This indicated to the researcher that DOD business is not considered attractive relative to commercial ventures. This conclusion would imply that under most circumstances, commercial ventures will always look more attractive to these firms. This also implied that in times of industry restructuring and full capacity utilization (such as in the 1980's), firms would always choose commercial ventures over DOD business.

Question 40 provided the survey respondent an opportunity to subjectively comment on any "other" reason (not previously listed in the survey) that was important to his decision not to participate in DOD business. The respondent was also asked to rank the importance of this

reason (if used) using the same scale for the previous 22 reasons. The following scaled responses, shown in Table 4-1, were received for question 40.

TABLE 4-1
SCALED RESPONSES TO QUESTION 40

RESPONSE SCALE VALUE	NO. OF RESPONSES
5	10
4	04
3	01
2	00
1	01
0 (NULL RESPONSE)	32
<hr/>	
TOTAL:	48

The 14 subjective "other" reasons provided by the survey respondents which received the strongest responses of four or five have been summarized below in Table 4-2 by the researcher. These question 40 "other" reasons which received a response of four or five were similar to many of the significant reasons for not participating in DOD business already analyzed. Of note was the first indication that under no circumstances would a particular firm participate in DOD business. The recurring emphasis on quality issues also was important because it parallels the standard responses already analyzed concerning quality issues.

TABLE 4-2

QUESTION 40 RESPONSES/COMMENTS

No. of Responses	Comment
(1)	Would not participate in DOD business under any circumstances
(1)	Unfairly defaulted by the Government
(1)	OSHA requirements forced me out of business
(1)	Lack of follow-on Government contracts
(1)	My prime DOD contractor is too inefficient and unknowledgeable about the foundry business
(1)	Commercial ventures are much less risky
(1)	DOD expects me to build prototypes at my own expense without guaranteeing a follow-on contract
(3)	Incomplete, or inaccurate out of date techdata packages
(4)	Inflexible, inconsistent quality requirements, lack of knowledgeable Government personnel on quality issues.

The two final questions in the survey asked the respondent to provide a subjective answer to the following questions:

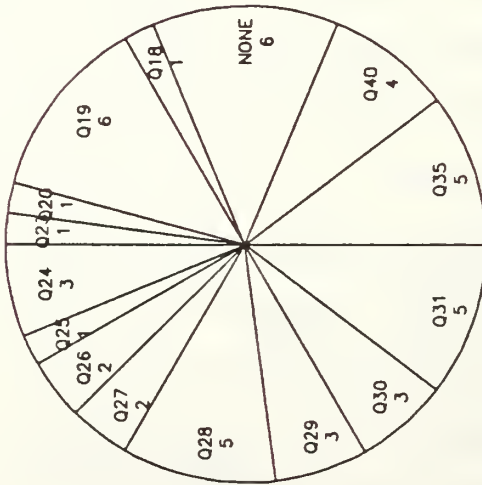
Question 41. Of all the reasons listed in questions 18 through 40, what is the one reason you consider the most important to your decision to not participate in DOD business? Please explain, perhaps with an example, the specifics of your choice.

Question 42. Under what conditions would you consider getting into DOD business or staying in DOD business? Please comment:

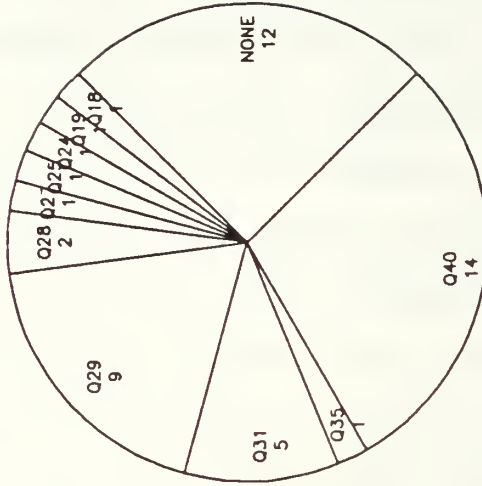
As discussed in Chapter III, these final two questions were designed to provide one last opportunity for the survey respondent to clearly discriminate which reason was the most important for not participating in DOD business, and under what conditions he would return to DOD business. These two questions were also intended to act as a final quality assurance check in terms of the consistency of a respondent's answers. It was assumed that the survey respondents could, and would, provide specific examples to support their most important reasons for not participating in DOD business. In order to facilitate computer analysis of these two questions, the researcher analyzed all 48 responses to these two questions and then classified them in one of the 22 "standard" reason categories or in the question 40 "other" reason category. Blank responses were classified as a zero or null response.

Figure 4-14 illustrates the results of this analysis. Figure 4-14 used pie charts to compare the responses to questions 41 and 42 to the overall skyscraper plot responses to the 22 "standard" reasons by all 48 firms. There appeared to be some deviation in the answers to question 41 from what would be expected based on the overall responses for the 22 standard reasons. Reason 19, burdensome paperwork was an example of this deviation. It was the number one response and was cited six times in question 41 as the most important reason for not participating in DOD

QUESTION 41 - ALL 48 FIRMS



QUESTION 42 - ALL 48 FIRMS



MOST IMPORTANT REASON NOT TO PARTICIPATE
 MEAN RESPONSES FOR 48 COMPANIES TO QUESTIONS 18 TO 39
 BY NON DOD CONTRACTORS

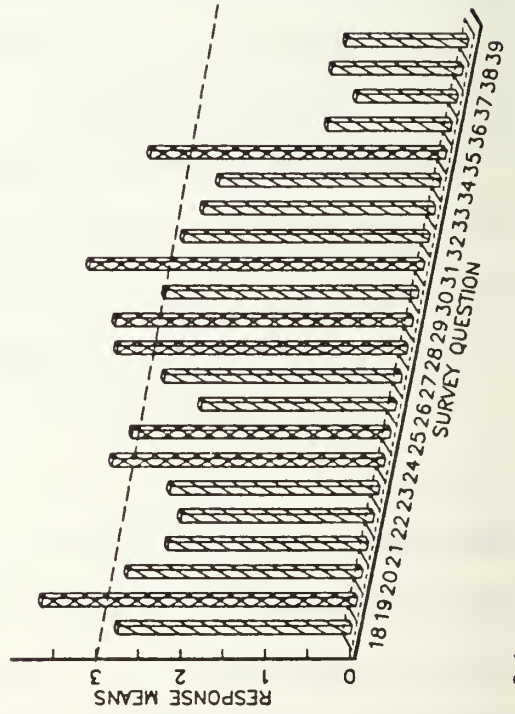


Figure 4-14 COMPARISON OF RESPONSES TO QUESTIONS 41 AND 42

business, yet it was the second most important reason in the overall response analysis. Reasons 28, 29 and 30 were used 11 times in response to question 41. This paralleled their importance in the overall response analysis where each of these reasons was significant and scored above the mean value of three. Reason 31, inflexible Government procurement methods/policies and reason 35, more attractive commercial sales both were cited five times in question 41. This again generally paralleled their similar importance in the overall mean response analysis but with a somewhat lower emphasis. Reason 24 also stood out, but less strongly than its overall response mean significance.

In the researcher's opinion if every respondent had provided an example (eliminating the six null responses), the responses to question 41 would have been more similar to the overall response analysis. Another factor which could have skewed these results was the inclusion of reason 40, the "other" category for the first time into a combined analysis. Finally the researcher may have incorrectly interpreted and classified some of the responses therefore biasing the data. The reader should note that reason 40 was not included in the original overall response mean analysis for the 48 firms.

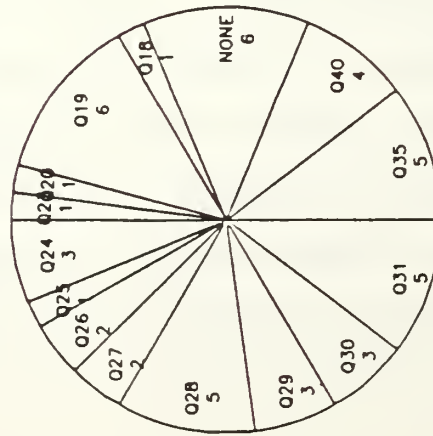
Analysis of question 42 in Figure 4-14 provided interesting insights into what these foundries considered the most important condition to change in order to stay in,

or return to DOD business. The largest number of responses (14) were classified as "other" reasons. Seven of these 14 reasons all dealt with the same frustration; lack of knowledgeable (of the foundry industry) Government personnel to talk with in order to solve technical problems. These foundries indicated that their inability to resolve technical problems with knowledgeable Government representatives would keep them out of this market until these people were available. Three of the 14 indicated they would not return to DOD business under any conditions and the remaining four responses all varied. Twelve firms did not respond to question 42 and these were classified as null responses. The size of this null response could represent apathy, frustration or lack of a clear idea about what conditions would have to change in order to return to DOD business. Reasons 28 and 29, both quality issues, received 11 responses. This again indicated to the researcher that widespread frustration with excessive and inconsistent quality requirements existed and was a significant reason for not participating in DOD business. In the quality reasons (reasons 28 and 29), cited for question 42, excessive specifications bearing little relationship to functional or performance requirements was cited in all 11 responses. Finally, five responses concerning inflexible Government procurement methods/policies were used. This response rate was much lower than the researcher assumed it

would be. Given that inflexible procurement methods/policies was repeatedly cited as the most significant reason for not participating in DOD business, the researcher expected this response to dominate both questions 41 and 42. However, it did not, and it is the researcher's opinion that the numerous quality issues cited by the respondents may be indirect manifestations of what are really inflexible Government procurement methods/policies "on" quality issues.

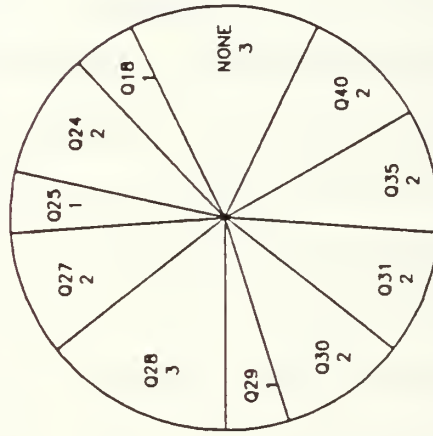
In a final analysis of the reasons why these foundries decided not to participate in DOD business, the researcher compared the survey responses to questions 41 and 42 between the GET OUT (21 firms) and STAY OUT (27 firms) groups to see if there were any significant differences between the reality of DOD business and perceptions about it. Figure 4-15 presents this analysis. The most striking difference between the GET OUT and STAY OUT responses to question 41 again dealt with quality issues. Quality reasons 28, 29 and 30 accounted for 29% of the responses for the GET OUT subcontractors and only 18% of the responses for the STAY OUT subcontractors. Reason 19, burdensome paperwork was not cited by the GET OUT group but was cited by 22% of the STAY OUT group. Other significant factors previously cited, such as reasons 31 and 35, inflexible procurement policies and more attractive commercial sales are almost equally (19% vs. 22%) used.

QUESTION 41 – ALL 48 FIRMS



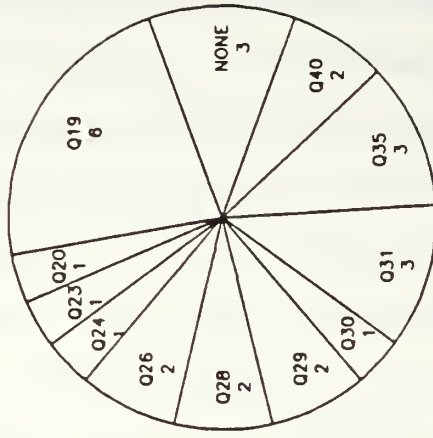
MOST IMPORTANT REASONS NOT TO PARTICIPATE

QUESTION 41 – GETTING OUT OF DOD BUSINESS



MOST IMPORTANT REASONS NOT TO PARTICIPATE

QUESTION 41 – STAYING OUT OF DOD BUSINESS



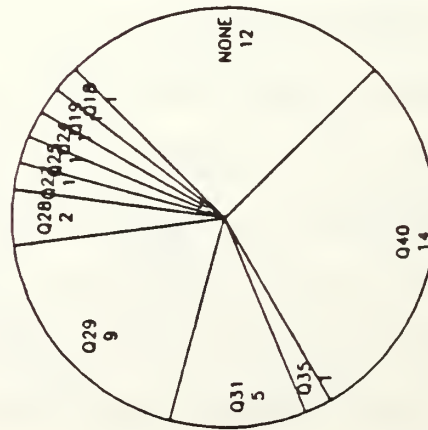
MOST IMPORTANT REASONS NOT TO PARTICIPATE

Figure 4--15 COMPARISON OF GET OUT/STAY OUT RESPONSES TO QUESTION 41

These findings support an evolving research hypothesis that the quality problems being experienced by the GET OUT group are actually more significant than the perception of quality problems in the STAY OUT group. They also suggest that the perception of burdensome Government paper work requirements may be more significant than the "actual" reality of the requirements.

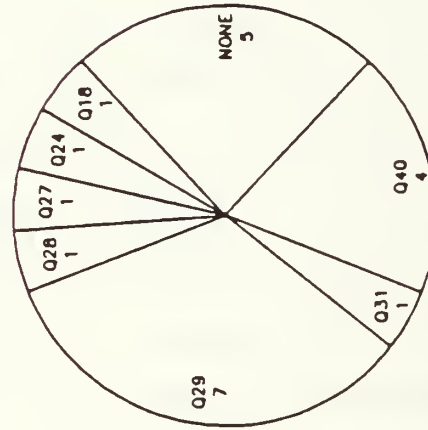
Figure 4-16 compares the GET OUT and STAY OUT responses to question 42. Again, quality reasons 28 and 29 represented 38% of the responses cited by the GET OUT group versus 11% for the STAY OUT group. Frustration over quality issues, in the opinion of the researcher, was clearly more important to foundries currently in DOD business and appear to be driving them out of the DOD market. Inflexible Government methods/policies was cited 15% of the time by the STAY OUT group versus five percent of the time for the GET OUT group. The researcher cannot explain this except to suggest that because the GET OUT group is still involved with DOD quality problems these reasons tend to overshadow what may really be inflexible procurement policies. The GET OUT and STAY OUT groups cited "other" reasons 19% and 37% of the time respectively. A breakdown of these reasons was provided in the discussion of Figure 4-14. The majority of those reasons dealt with the lack of knowledgeable Government personnel to contact when attempting to resolve technical problems. Of note was the fact that two of the

QUESTION 42 - ALL 48 FIRMS



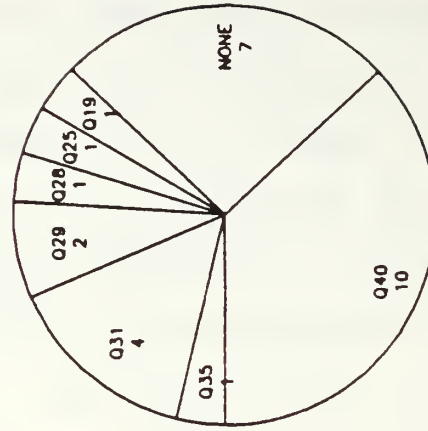
MOST IMPORTANT CONDITIONS TO CHANGE ATTITUDE

QUESTION 42 - GETTING OUT OF DOD BUSINESS



MOST IMPORTANT CONDITIONS TO CHANGE ATTITUDE

QUESTION 42 - STAYING OUT OF DOD BUSINESS



MOST IMPORTANT CONDITIONS TO CHANGE ATTITUDE

Figure 4-16 COMPARISON OF GET OUT/STAY OUT RESPONSES TO QUESTION 42

"other" responses for the GET OUT group were "under no conditions" would they return to DOD business.

This concludes the analysis of the refusal reasons. The researcher will now present several hypothesis tests which were conducted on the data in order to determine if any explanatory factors existed.

3. Explanatory Factors Analysis

Earlier in this chapter the researcher presented a demographic analysis of the survey results. This analysis was used to validate a number of the researcher's assumptions and to illustrate the differences between DOD and NON-DOD contractors. If the reader will remember, NON-DOD contractors represented those firms which passed both survey filters. In comparing the demographic response data of NON-DOD contractors and DOD contractors the researcher hoped to isolate any significant explanatory factors which discriminated between the two populations. An example of an expected explanatory factor would be the hypothesis that larger foundries are more likely to remain DOD contractors than smaller foundries. In the opinion of the researcher, based on the data presented in Figures 4-2 through 4-9, no significant explanatory factors such as size, total sales, casting process and metals used could be identified which discriminated between DOD and NON-DOD contractors. The graphical data representations were essentially uniform for both populations in each figure. While no explanatory

factor conclusions can be drawn from this observation, the researcher can state that the two populations nearly mirror each other.

Because no explanatory factors appeared in the analysis of the DOD and NON-DOD populations the researcher decided to perform the same type of analysis on the GET OUT and STAY OUT populations by formulating the following series of hypothetical questions:

1. Is the type of casting process an explanatory factor for the GET OUT and STAY OUT subcontractors?
2. Is the metal type an explanatory factor for the GET OUT and STAY OUT subcontractors?
3. Is the number of employees an explanatory factor for the GET OUT and STAY OUT subcontractors?
4. Is the type of foundry business an explanatory factor for the GET OUT and STAY OUT subcontractors?
5. Is prime contractor involvement in DOD business an explanatory factor for the GET OUT and STAY OUT subcontractors?
6. Is total annual sales size an explanatory factor for the GET OUT and STAY OUT subcontractors?

Figures D-1 through D-6 graphically illustrate differences between the GET OUT and STAY OUT subcontractors for each of these hypothetical questions and are contained in Appendix D. Unfortunately, this data analysis also provided no significant differences between the two populations for any of these factors.

C. SUMMARY

This chapter presented a detailed analysis of the survey response data provided to the researcher. Data analysis was also conducted on several important subsets of the total survey population. While the data portrayed in this chapter were not gathered from a statistically random sample, they are useful in determining the attitudes and opinions of the population of survey respondents. Approximately 20% of the survey respondents indicated that they refuse, or intend to refuse, to participate in DOD business. Because these foundries are in a shrinking domestic nonferrous foundry base, the reasons why they refuse to participate in DOD business are particularly important to DIB planners and policymakers.

The most significant overall reasons for refusing, or intending to refuse, to participate in DOD business are remarkably consistent between the overall survey population and its two subsets: the GET OUT subcontractors and STAY OUT subcontractors. These most significant reasons tend to substantiate many, but not all, of the reasons hypothesized in the literature and studies reviewed by this researcher. The differences were noted where appropriate, within the text of this chapter.

Also presented in this chapter was a brief analysis of the least important reasons for not participating in DOD business. These least important reasons appear to

contradict some of the frequently cited reasons in the literature for not participating in DOD business. In Chapter II, this researcher cited reasons considered important to a subcontractor's decision not to participate in DOD business. Some of those reasons which were cited, but do not appear to be significant in this study, included the following:

- lack of production capability/capacity to accept Government work,
- use of foreign sources of supply for production materials,
- contract termination by the Government or prime contractors,
- losing contracts to other competitors in a price competition environment,
- adversarial prime/sub contractor relationships, and
- not knowing how to obtain Government subcontracts.

The six, clearly most significant, reasons for not participating in DOD business are listed below along with a summary explanation/comment. These summary explanations/comments were derived by the researcher from the various examples provided by the survey respondents to question 41 and from informal, non-attribution interviews. These statistically significant reasons for not participating in DOD business are listed in order of most important to least important.

Reason 31: Inflexible Government procurement policies/methods. This was the most important reason for not participating in DOD business throughout the study. All

groups consistently ranked it the highest. Numerous comments were received concerning the inability of the Government to be flexible when it came to various "grey" areas of procurement policy. Government procurement policies were viewed as "unfair" and "rigged" in favor of "other firms." An attitude of "us" versus "the Government" was prevalent. The Government was widely believed to have unfair advantages, particularly with problems and disputes. Finally, there appeared to be nearly universal concern over the lack of a common sense approach to the procurement process with respect to the technical limitations of casting as a manufacturing process.

Reason 19: Burdensome paperwork requirements. This reason was consistently cited by all groups. However, it was considered more significant by STAY OUT subcontractors. Burdensome paperwork throughout the procurement process was cited, particularly "paperwork not related to product specification or quality." The perception was that a growing magnitude of miscellaneous reports was strangling all but the largest businesses. This added paperwork creates additional overhead costs that these predominately small businesses cannot afford. In many cases, the "paperwork involved just to bid, costs more than the product." The sheer size/volume of techdata packages and bid and proposal packages was seen as overwhelming.

Reason 35: More attractive commercial sales to non-DOD prime contractors. This reason was consistently cited by all groups. Again this reason was considered more significant by STAY OUT subcontractors. Commercial sales to NON-DOD contractors were universally cited as more profitable and less aggravating. Specifications used in commercial sales are widely recognized industry or commercial standards. Knowledgeable customer engineers were available to resolve technical problems. Commercial customers encourage innovation and "listen" to the foundry's suggestions for product improvements. Finally, in commercial sales you don't have to deal with "bureaucrats." One foundryman said "when I'm busy, why bother?"

Reason 29: Overly restrictive (too high) quality standards. This reason was consistently cited by all groups, however the GET OUT subcontractors found it more significant. This reason reflected numerous contractor frustrations over excessive, unrealistic specifications, impossible to achieve specifications, and specifications not consistent with the latest technology. Specifications were often old, incomplete and incompatible with the casting process required. Excessively "tight" dimensional requirements were cited on surfaces which would ultimately be machined down. "Gold plated" specifications which have no relationship to performance or function are often required, greatly increasing the cost and complexity of the

casting. When these specification problems are identified by the foundry and communicated to the procuring activity/prime contractor "no one seems to care" or has the "authority to answer my question." The need for stringent specifications on aerospace, submarine and safety systems was recognized. These frustrations apply to other non-critical applications.

Reason 28: Inconsistent quality requirements. This reason was consistently cited by all groups, however it was more significant to the STAY OUT subcontractors. The only thing that appeared more frustrating than excessive, unrealistic specifications were inconsistent ones. Quality standards for the same cast products are inconsistently applied by different prime contractors and various military customers. Lack of an universally acceptable industry quality standard causes foundries to not "know where you stand" until inspection of the final cast product. Continual quality inspector personnel changes were cited as contributing to the problem. Examples of production lots that were accepted by one inspector and rejected by another were offered. Quality inspectors from both the prime contractors and the Government are inadequately trained to do their jobs. Arbitrary rejection of cast products for "purely cosmetic" defects unrelated to form, fit or function was repeatedly cited.

Reason 24: Low profitability/lost money on Government related subcontracts. This final reason was also consistently cited by all groups, however it was more significant to GET OUT subcontractors reflecting their actual experiences with DOD business. "It's easy to lose money" was the common thread through most of the comments. The "real" costs of this paperwork combined with the current emphasis on price competition by the primes and the Government has significantly cut profit margins. Lack of "adequate, realistic definitions of requirements," changes in specifications, the uncertainty of production volume and "internal interruptions" also cause lost profits. The increasing demands on contractors to fund development programs increasingly place small business subcontractors at risk. Commercial sales are universally believed to be safer and more profitable.

In an increasingly competitive international marketplace for castings, each of these factors provides a powerful incentive for a foundry to exit the DOD marketplace in order to avoid these risks, additional costs and "frustrations." At least 20% of the population sampled by this researcher has exited this market due to these (and other) factors. In the researcher's opinion, this non-participation rate is probably applicable industry wide. These observations, when placed in the context of a declining domestic foundry base, should be an alarming

concern for Defense Industrial Base planners and military users of high quality nonferrous castings. They portend longer leadtimes, higher costs and fewer competitive high quality producers in the future and whenever existing capacity is fully utilized by commercial demand.

This concludes the analysis and interpretation of the survey data. Chapter V presents the principal findings, conclusions and recommendations resulting from this research and suggests areas for future research.

V. PRINCIPAL FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

The objective of this study was to determine the extent and reasons for nonferrous foundry subcontractor refusal to participate in Department of Defense (DOD) business. The principal findings and conclusions were derived through an analysis of subcontractor survey response data and informal, non-attribution telephonic and personal interviews. Several significant findings and conclusions can be drawn from the survey data and interview observations resulting from this research. Some of these have implications for the Defense Industrial Base (DIB) while others impact current procurement and regulatory policies.

B. FINDINGS AND CONCLUSIONS

#1. Incentives to not participate in DOD business exist for DIB subcontractors. As discussed in the thesis, the powerful economic and regulatory forces affecting all DOD contractors are more acutely felt by lower tier subcontractors. Because of their small sizes, reduced technical and managerial capabilities, and the limited financial resources available to them, DOD subcontractors face greater economic risks than the larger prime contractors when dealing with an unstable DOD business environment. They face these

increased risks without many of the beneficial or protective contract flow down available to the primes. They are often subject to the "risk-shifting" practices by the primes and virtually never receive any of the IMIP, TECHMOD or MANTECH type "seed" monies from the Government or prime contractors. The increased risks, substantial regulatory requirements and emphasis on price competition in today's DOD marketplace is providing these subcontractors with powerful incentives to pursue commercial vice DOD business. Until these policies change, commercial sales will always appear more attractive, particularly when existing capacity is strained by commercial demand. These forces have caused substantial erosion of the DIB in its critical lower tiers.

#2. Defense Industrial Base capability/productivity concerns should focus on lower tier subcontractors. The ongoing controversy over the erosion of the DIB and whether or not it is capable of supporting potential surge and mobilization requirements is misdirected. Adequate or excess productive capacity appears to exist in virtually all segments of the DIB at the prime contractor level. While the absolute number of firms has declined, overall capacity generally has not. A much more significant capacity problem exists in the supporting lower tiers of the DIB. This lower tier subcontractor capacity problem significantly limits the ability of the major prime contractors to "ramp up" and utilize existing capacity. Industrial "bottlenecks" result

in areas where a few critical industrial subcontractors support numerous prime contractors. The bearing, forging, foundry, semi-conductor, optical and machine tool and die industries are examples of these "bottleneck" industrial subcontractors. Sparrow missile production could be "ramped up" in a matter of months. Developing the titanium foundry capacity to support it could take years. Supporting these lower tier industrial subcontractors are even lower level service subcontractors such as the pattern makers in the foundry industry. It takes five to ten years to train a skilled pattern maker. Considering patterns are required in 100% of all castings produced, foundry capacity would be constrained for years if faced with huge increases in demand for new cast products (such as in war time).

#3. The domestic nonferrous foundry base has declined at least 15% in numbers of firms and in capacity over the last ten years. The domestic foundry base has been continually declining in both numbers of firms and in capacity for the last 25 years. Restructuring within the industry continues today with fewer and fewer high quality nonferrous foundries able or willing to participate in DOD business. Nonferrous castings have widespread, critical applications in DOD aerospace, combat vehicle and naval weapon systems. DOD consumption of high quality nonferrous castings is growing yearly. Virtually 100% of certain specialized castings such as titanium castings are consumed

by DOD. High nonferrous foundry capacity utilization and growing DOD requirements are creating longer leadtimes and higher costs for high quality nonferrous castings. These longer leadtimes lead to "bottleneck production delays" in many weapon systems.

#4. Tremendous subcontractor frustration over Government/prime contractor procurement policies and quality issues exists in the nonferrous foundry industry. As analyzed in the thesis, the data obtained from interviews and subcontractor surveys reflected extreme frustration with Government/prime contractor procurement policies and quality issues. This frustration is causing significant numbers of nonferrous foundry subcontractors to exit the DOD marketplace. Procurement policies are universally perceived to be unfair, inflexible, inconsistent and lacking common sense. Quality issues are a chronic problem for these foundries. Accurate, up-to-date specifications consistent with current technology and the limitations of particular casting processes are not available. There is widespread frustration with excessive Government/prime contractor overspecification which dramatically increases the complexity and cost of cast products. More importantly, when technical and quality problems are discovered, there are few if any knowledgeable Government/prime contractor representatives available with the authority to "make a decision" or "to solve the problem." Lack of universal

quality standards and inconsistent application of the existing ones leads to production delays and increased product costs. Finally, subcontractors believe there are few if any, adequately trained Government/prime contractor quality inspectors. These frustrations make commercial sales alternatives appear much more attractive than DOD business.

#5. Twenty percent of the nonferrous foundry subcontractors responding to the survey indicated that they refuse, or intend to refuse, to participate in DOD business.

Twenty percent of the survey respondents indicated that they intend to STAY OUT or GET OUT of DOD business. This non-participation rate is remarkably similar to the Lamm research findings cited in Chapter II of this thesis. However, these findings differ significantly in the fact that this researcher specifically targeted one industry and then excluded all potential respondents who did not identify themselves as subcontractors. The principal overall reasons that nonferrous foundry subcontractors refuse to participate in DOD business are: 1) inflexible Government procurement methods/policies, 2) burdensome paperwork requirements and 3) more attractive commercial sales to non-DOD prime contractors.

#6. Some hypothesized reasons for not participating in DOD business were not important to nonferrous foundry subcontractors. The literature review provided numerous

hypothesized reasons for not participating in DOD business. Many of these reasons were not important to nonferrous foundry subcontractors. The four least significant reasons for not participating in DOD business are: 1) inability to use normal foreign sources of supply for production materials, 2) do not have the production capability/capacity to accept Government work, 3) previous contract(s) terminated, and 4) lost DOD subcontract business to other competitors. These least important reasons are important because they challenge several significant assumptions often made about the conditions faced by lower tier subcontractors. Production capacity/capability problems are often assumed to be an acute problem for foundry subcontractors. This was not substantiated by the data collected. It is also often assumed that intense price competition at the subcontractor level is driving firms out of the DOD marketplace for high quality, inexpensive castings. This too was not substantiated by the data.

#6. There are differing reasons for GETTING OUT of DOD business and STAYING OUT of DOD business among nonferrous foundry subcontractors. GET OUT nonferrous foundry subcontractors are those subcontractors who currently participate in DOD business but intend to stop. Their reasons for refusing to participate in future DOD business reflect the current reality of their experiences while

participating in DOD business. The principal reasons why these GET OUT firms intend to stop participating in DOD business are: 1) inflexible Government procurement methods/policies, 2) overly restrictive quality requirements, and 3) low profitability. STAY OUT nonferrous foundry subcontractors are those subcontractors which never participated, or used to participate, in DOD business. Their reasons for refusing to participate in DOD business reflect their perceptions or memories of what participation in DOD business would be/was like. The principal reasons why these STAY OUT firms do not participate in DOD business are: 1) inflexible Government procurement methods/policies, 2) burdensome paperwork requirements, and 3) more attractive commercial sales to non-DOD prime contractors. The different reasons these two groups have for not participating in DOD business are due to experiential and perceptual factors.

#7. Potentially serious weapon system procurement and supply support problems will develop and worsen. As discussed throughout this thesis, these findings carry serious implications for current and future weapon systems procurement leadtimes and costs. As the domestic foundry base continues to restructure, fewer foundries with reduced capacity will remain. These remaining foundries will be increasingly unwilling to accept DOD business as long as existing capacity is utilized by more attractive commercial

demand. Domestic nonferrous foundry capacity utilization is currently over 77%, and has remained over 70% this entire decade. Full capacity utilization of exiting foundries, combined with fewer foundries willing to participate in DOD business, will aggravate leadtime problems and create higher costs. Frustration over Government/prime contractor procurement and quality policies combined with an intense price competition DOD business environment will cause this trend to worsen over time.

C. RECOMMENDATIONS

#1. Continue to expand acquisition streamlining efforts. An unnecessarily costly and complex procurement environment currently exists. This environment unfortunately provides numerous economic and psychological incentives to small businesses to exit the DIB in order to avoid such things as burdensome paperwork and overspecification. Every effort possible should be made to eliminate unnecessary regulations, paperwork, non-commercial specifications and to introduce "common sense, sound business judgment" management philosophies and procurement practices. Streamlining efforts should evaluate and take into account the cumulative effects of "piece meal" regulatory, tax and profit policies imposed over the last five years and attempt to minimize their negative impact.

#2. Continue and expand efforts to "educate" small businesses on how to do business with DOD. Much of the

frustration involved with doing business with the Government results from a lack of understanding. Misunderstanding, or not understanding, Government procurement policies, bidding methods, and quality requirements is frustrating for the foundry industry and ultimately results in fewer competitive sources for the Government. Small businesses, to the extent possible, must be made to understand the objectives, spirit and intent of the various procurement policies affecting them. All interests would be well served by expanding such efforts as DOD procurement workshops sponsored by both industry trade associations and DOD activities.

#3. Initiate an industry/DOD effort to develop universal quality standards for production, inspection and acceptance of cast products. This effort should include the foundry industry, major DOD prime contractors and DOD representatives. Engineers, production managers and procurement personnel from each organization should participate. Universal production, inspection and acceptance quality standards incorporating the latest technologies as well as the inherent limitations of different castings processes should be developed by this group. Military specifications should be based on, and consistent with, these standards where ever possible. Once these quality standards have been developed both industry and Government buyers and inspectors must be trained in their consistent and appropriate use.

#4. DOD should emphasize value over price in specialized high quality castings. DOD and prime contractors should emphasize the "best value concept" when developing and maintaining foundry capacity for high quality, specialized castings. Intense price competition at the subcontractor level combined with the numerous factors already discussed are forcing high quality foundries out of the DOD marketplace. Non-price factors such as technical ability, previous quality performance and manufacturing process controls must be strongly emphasized in the procurement process in order to maintain a high quality nonferrous foundry base willing to accept DOD business.

D. ANSWERS TO THE RESEARCH QUESTIONS

The following are a reiteration of the primary and subsidiary research questions. Their answers are based on the conclusions drawn from this research effort.

Primary Research Question--To what extent do foundry subcontractors refuse to participate in DOD business? Twenty percent of the nonferrous foundry subcontractors responding to the survey indicated they refuse, or intend to refuse, to participate in DOD business.

Subsidiary Research Questions--What are the key reasons for refusing DOD business? The seven most significant reasons for refusing to participate in DOD business are (listed in order of most to least importance):

1. inflexible Government procurement methods/policies
2. burdensome paperwork requirements
3. more attractive commercial sales to non-DOD prime contractors
4. overly restrictive (too high) quality standards
5. inconsistent quality requirements
6. low profitability/lost money on Government related subcontracts
7. prime contractor/higher level subcontractor contracting methods/policies on DOD related business.

Can any foundry industry trends be identified? The foundry industry is restructuring. It is declining in numbers of firms and overall capacity. Existing capacity in the nonferrous foundries is nearly fully utilized. Increasing numbers of the remaining nonferrous foundries are apparently unwilling to participate in DOD business. This trend should be expected to worsen over time.

What procurement reforms would have the greatest impact on foundry willingness to accept DOD business? Streamline current procurement policies and regulations. Simplify the bidding and proposal process, eliminate unnecessary paperwork, develop and maintain current commercial standard quality specifications for production, inspection and acceptance. Train Government/prime contractor personnel in their appropriate use. Decrease current policy emphasis on price competition and emphasize a "best value to the Government concept."

What are the implications for procurement policy? The implications for procurement policies are substantial. Significant changes in current procurement regulations and their management philosophies will be required to implement these changes. These changes are required to do two things: 1) maintain a viable domestic nonferrous foundry base which is capable of, and willing, to participate in the DIB, and 2) obtain high quality, reasonably priced nonferrous castings. The researcher has no doubt that changing these statutory requirements and their associated crushing burden of costly, inefficient and ineffective regulations will be a monumental task--but a necessary one.

E. RECOMMENDATIONS FOR FUTURE RESEARCH

1. Database Searches

Further study in the area of the reasons why firms refuse to participate in Government business is required. Additional databases not used by this researcher but worthy of exploration in future research include Department of Commerce databases associated with its U.S. Industrial Outlook publications. These databases contain a wealth of industrial economic, trade, production and technical data. The future researcher could also explore the Dun and Bradstreet Market Services database in greater detail for data at the individual firm level.

The researcher should be reminded that the use of any Government maintained database (such as the previously

described PASS database) will probably introduce survey sampling bias. This is due to the inherent contradiction of trying to locate firms that do not want to participate in Government business by researching Government databases maintained for the purpose of expanding and cataloging participation in DOD business.

2. Alternative Research Methodologies

Future research in this subject area could prove beneficial if the research methodology was changed from "chunk" surveying populations believed to be unwilling to participate in DOD business to an analysis of critical weapon systems and the prime/subcontractors supporting those systems. The research should focus on any production constraints/bottlenecks that may exist at the prime contractor level due to limited or sole source subcontractors. Based on prime contractor purchasing department inputs, a survey of the capabilities, capacity and attitudes of these subcontractors along with a search for known or suspected firms which are unwilling to participate in DOD business could follow. Prime contractors from various DOD critical industries could be used for this purpose.

3. Alternative Industries

Alternative industries could be chosen as candidates for the same research methodology employed by this researcher. These candidate industries should be chosen

from the list of "critical" DIB industries identified by this researcher and others. The forging or machine tool industries would be logical and important candidates.

APPENDIX A

REASONS WHY COMPANIES REFUSE TO PARTICIPATE IN DOD BUSINESS

Reason	Frequency	(%)	Cited*	
			1st	2nd
Burdensome paperwork	147	69.0	60	26
Government bidding methods	121	56.8	22	31
Inflexible procurement policies	81	38.0	7	13
More attractive commercial ventures	73	34.3	7	9
Low profitability	69	32.4	10	6
Government attitude(s)	69	32.4	3	10
Delays in making awards	60	28.2	2	4
Inconsistent quality requirements/ standards too high	47	22.0	10	11
Other (entered by respondent)	46	21.6	10	7
Late payment/nonpayment	45	21.1	6	4
Uncertainty/instability of government business	36	16.9	2	2
Audit procedures	31	14.6	—	—
Unfair application of regulations	30	14.1	4	3
Technical data rights problems	27	12.6	7	3
Frequent contract changes	24	11.3	—	1
Acceptance/rejection of product	23	10.8	—	6
Inefficient production levels/rates	20	9.2	1	4
Lost business to competitors	18	8.6	2	3
Prime contractor/higher-tier sub- contractor methods	16	8.3	2	1
Work set aside for small business	13	6.1	6	—
Not enough defense business	13	6.1	4	—
GFE problems	9	4.2	1	—
Adverse court/board ruling	8	3.8	—	—
Adverse GAO decision	5	2.3	1	—
Contract(s) terminated	4	1.9	—	—

*Forty-seven firms failed to prioritize the reasons.

Source: Lamm, "Why Firms Refuse DOD Business: An Analysis of Rationale," NCMA Journal, Winter 1988.

APPENDIX B

THE SURVEY QUESTIONNAIRE

22 February 1988

Lt. Jon A. Schaubert
SMC # 1517
Naval Postgraduate School
Monterey, Ca. 93943-5100
Phone: 408-372-1412

Dear Sir:

This is a letter of introduction and a request for assistance in a Master's Thesis research project on the Defense Industrial Base.

My name is Lt. Jon A. Schaubert and I am an active duty Naval Officer in the U. S. Navy Supply Corps. I am currently a full time graduate student at the Naval Postgraduate School where I am working on an M.S. in Management.

My Master's Thesis research work is focused on the lower tiers of the Defense Industrial Base and concerns over its apparent erosion. Specifically, I am trying to analyze the reasons why capable subcontractors refuse to participate in Department of Defense (DOD) business. My research goal is to determine the extent of the problem, (if it exists), and the key reasons for refusing to accept DOD business.

The Castings Industry is critical to the Department of Defense. It is often cited by government policy makers as an example of how our rapidly shrinking industrial base is creating unacceptably long leadtimes for components in today's complex weapons systems. Worse; it is often used as an example to illustrate the negative consequences of ineffective government policies, lack of industry capital investment and subsidized foreign competition.

For these reasons, and with your help, I would like to focus my research efforts on the Castings Industry. Could you please take a few minutes of your time to complete the enclosed survey and return it at your earliest convenience? You may not be asked to complete the entire survey and all of your responses will remain strictly confidential. The survey results will be used for academic research analysis on Defense Industrial Base concerns and for recommending DOD procurement policy changes. Hopefully, any policy recommendations resulting from this survey will help improve and strengthen the business relationship between the Department of Defense and companies such as yours.

Thanking you in advance for your assistance,

Jon A. Schaubert

Encl.

Lt. Jon A. Schaubert, SC, USN
Naval Postgraduate School
SMC # 1517
Monterey, CA. 93943

SURVEY OF NONFERROUS CASTING INDUSTRY OPINION
ON DEFENSE SUBCONTRACT BUSINESS

This survey is designed to solicit your ideas and concerns about Department of Defense (DOD) procurement policies and procedures at the subcontractor level. The goal of the survey is to determine why firms do not desire to participate in DOD business at the subcontractor level.

Please take a few minutes of your time to give us your honest answers to these survey questions. You may remain anonymous if you wish. All answers will remain confidential and will only be used for research analysis. Please circle one answer per question which best describes your situation or answer in the space provided. Thank you for your assistance.

1. Please briefly describe your primary cast products:

2. Please describe the commercial and/or DOD uses for your primary cast products: (if known)

3. My primary Standard Industrial Code (SIC) is: _____

4. What casting process do you primarily use?

1. Investment casting
2. Die casting
3. Sand mold casting
4. Permanent mold casting
5. other _____

5. What metal/alloy type do you primarily cast with?
1. Aluminum
 2. Nickel base
 3. Magnesium
 4. Zinc
 5. Titanium
 6. Cobalt/Chromium
 7. other_____
-
6. Please indicate your approximate number of employees.
1. 0 to 19
 2. 20 to 49
 3. 50 to 99
 4. 100 to 249
 5. 250 to 499
 6. 500 to 999
 7. 1000 and over
7. Is your company affiliated through ownership with other companies?
1. Yes
 2. No
8. If you answered yes to question 7, please indicate the total employment of your company and your affiliated companies:
1. 0 to 19
 2. 20 to 49
 3. 50 to 99
 4. 100 to 249
 5. 250 to 499
 6. 500 to 999
 7. 1000 and over
9. Which of the following best describes your foundry business?
1. exclusively jobbing (production for sale to others)
 2. primarily jobbing
 3. exclusively captive (production for own use)
 4. primarily captive
 5. other_____
-
10. If you answered #1 or #2 in question 9, are the firms you sell to/subcontract with involved in Department of Defense business?
1. Yes
 2. No
 3. I don't know

11. What percentage of your sales go to? approximate %
1. Local customers (within 100 miles radius) _____
 2. Regional customers (northeast, etc.) _____
 3. National customers _____
 4. International customers _____
12. What is the approximate total annual sales volume of your company?
1. Less than \$100,000
 2. \$100,000 to \$500,000
 3. \$500,001 to \$1,000,000
 4. \$1,000,001 to \$5,000,000
 5. \$5,000,001 to \$10,000,000
 6. \$10,000,001 to \$50,000,000
 7. \$50,000,001 to \$100,000,000
 8. over \$100,000,000
13. Do 50% or more of your total annual sales result from subcontract work?
1. Yes
 2. No

IF YOU ANSWERED NO TO QUESTION 13, PLEASE STOP AND RETURN THIS SURVEY USING THE ENVELOPE PROVIDED. THANK YOU FOR YOUR TIME AND EFFORT.

IF YOU ANSWERED YES TO QUESTION 13, PLEASE CONTINUE THE SURVEY.

DEFINITION: In this study "Defense" procurement, business and contracting all refer to sales of materials or services to the Department of Defense. These sales may be direct to the government, while acting as a prime contractor for the Department of Defense, or indirect, when a subcontractor sells to a prime contractor who is doing business with the government.

Using the above definition of defense business, please consider the following statements concerning DOD business:

#1. I currently participate in DOD business but intend to get out of it.

#2. I currently do not have any DOD business and intend to stay out of it.

14. Do either of the above statements describe your attitude concerning DOD business?

1. Yes
2. No

IF YOU ANSWERED NO TO QUESTION 14, PLEASE STOP AND RETURN THIS SURVEY USING THE ENVELOPE PROVIDED. THANK YOU FOR TIME AND EFFORT.

IF YOU ANSWERED YES TO QUESTION 14, PLEASE CONTINUE THE SURVEY.

15. Which of the statements listed above concerning DOD business best describes your situation?

1. I'm IN DOD business but intend to GET OUT
2. I'm OUT of DOD business and intend to STAY OUT

IF YOU CHOSE ANSWER #1 ABOVE, PLEASE SKIP TO QUESTION 18.
IF YOU CHOSE ANSWER #2 ABOVE, PLEASE CONTINUE.

16. If you do not currently participate in DOD business which of the following best describes your DOD business experience?

1. We have never tried making sales to the government.
2. We have tried but never made sales to the government.
3. We have made such sales in the past but do not now.

17. If you were involved in DOD business in the past but are not now, how long ago were you involved in DOD business?

1. 0 to 6 months ago
2. 7 to 12 months ago
3. 1 to 2 years ago
4. 2 to 5 years ago
5. greater than 5 years ago

Please carefully review all of the following reasons for not participating in DOD business. After reviewing all of the reasons, please indicate the importance of each reason to your decision to get out of DOD business or to stay out of DOD business. Please use the following response scale for each question:

- 1 = not important at all to my decision
- 2 = somewhat important to my decision
- 3 = important to my decision
- 4 = very important to my decision
- 5 = the most important reason for my decision

My/our company does not participate in, or intends to stop participating in, DOD business because of:

18. prime contractor late payment or non-payment of bills:

1 2 3 4 5

19. burdensome paperwork requirements:

1 2 3 4 5

20. prime contractor contract flow-down requirements:
1 2 3 4 5
21. adversarial government/prime contractor relationships:
1 2 3 4 5
22. adversarial prime/sub contractor relationships:
1 2 3 4 5
23. uncertainty/instability of government business base:
1 2 3 4 5
24. low profitability/lost money on government related
subcontracts:
1 2 3 4 5
25. prime contractor/higher level subcontractor contracting
methods/policies on DOD related business:
1 2 3 4 5
26. we don't know how to obtain government subcontracts:
1 2 3 4 5
27. government/prime contractor auditing requirements/
procedures:
1 2 3 4 5
28. inconsistent quality requirements:
1 2 3 4 5
29. overly restrictive (too high) quality standards:
1 2 3 4 5
30. acceptance/rejection problems with my product:
1 2 3 4 5
31. inflexible government procurement methods/policies:
1 2 3 4 5
32. delays in making awards/frequent contract changes:
1 2 3 4 5
33. inefficient production levels/rates:
1 2 3 4 5
34. we have heard too many "horror" stories about DOD
business:
1 2 3 4 5
35. more attractive commercial sales to non-DOD prime
contractors:
1 2 3 4 5

36. do not have production capability/capacity to accept government work:

1 2 3 4 5

37. government will not let me use my normal foreign sources of supply for production materials/requirements:

1 2 3 4 5

38. lost DOD subcontract business to other competitors:

1 2 3 4 5

39. previous contract(s) terminated:

1 2 3 4 5

40. other reason(s): _____

1 2 3 4 5

41. Of all the reasons listed in questions 18 through 40, what is the one reason you consider the most important to your decision to not participate in DOD business? Please explain, perhaps with an example, the specifics of your choice.

42. Under what conditions would you consider getting into DOD business or staying in DOD business? Please comment:

43. I am willing to discuss my views by:

```
a. phone:      yes      no
```

b. personal interview: yes no

44. (OPTIONAL) :

Name: _____

Company: _____

Address: _____

Phone: ()

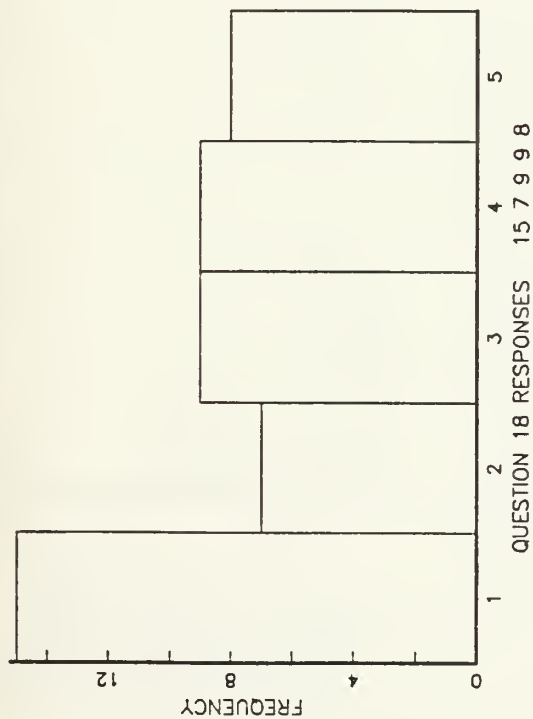
THIS IS THE END OF THE SURVEY. THANK YOU FOR YOUR TIME,
EFFORT AND COMMENT. PLEASE RETURN THIS SURVEY IN THE
ENVELOPE PROVIDED.

APPENDIX C

STATISTICAL ANALYSIS OF RESPONSES TO SURVEY QUESTIONS 18-39

The following GRAFSTAT statistical analysis was performed on each of the 22 survey refusal reasons and their associated responses. This analysis includes frequency histograms, box and whisker plots and basic descriptive statistics.

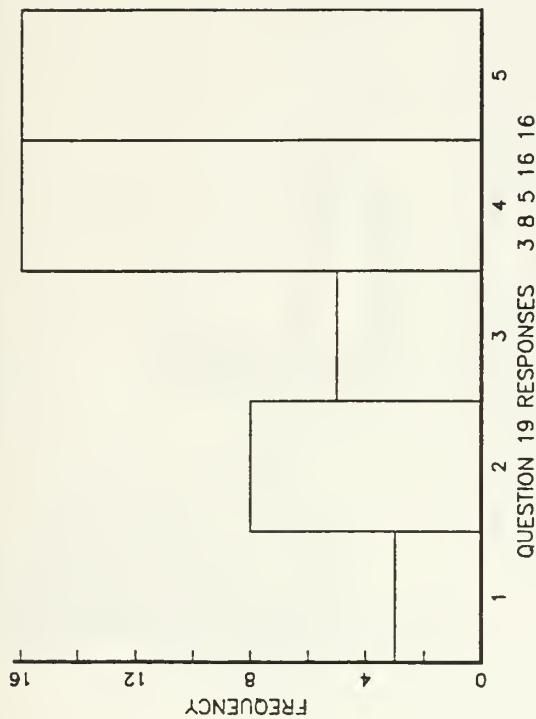
QUESTION 18: LATE/NON-PAYMENT



HISTOGRAM TABLE

X
SELECTION :Q18
X LABEL :ALL
NO. OF ELEMENTS :48
X MEAN :2.75
STD. DEVIATION :1.4947
SKEWNESS :0.1642
KURTOSIS :1.6106
5-PERCENTILE :1
25-PERCENTILE :1
MEDIAN :3
75-PERCENTILE :4
95-PERCENTILE :5
X MIN. :1 1 1
X MAX. :5 5 5

QUESTION 19: PAPERWORK REQMTS

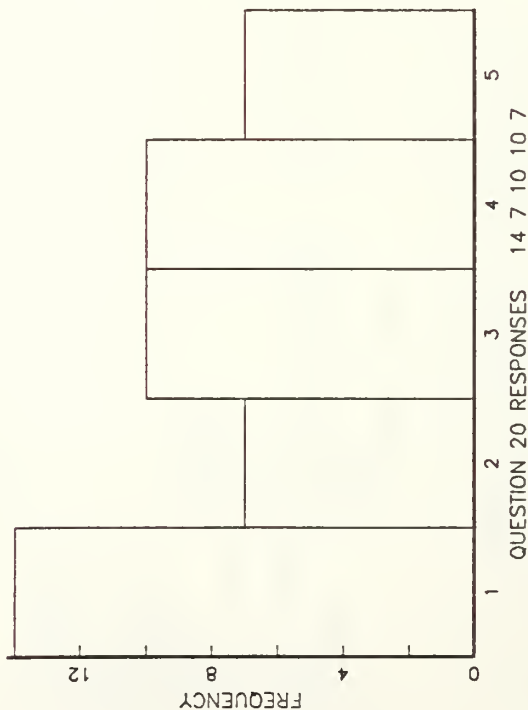


HISTOGRAM TABLE

X
SELECTION :Q19
X LABEL :ALL
NO. OF ELEMENTS :48
X MEAN :3.7083
STD. DEVIATION :1.2709
SKEWNESS : -0.69529
KURTOSIS :2.2942
5-PERCENTILE :1
25-PERCENTILE :3
MEDIAN :4
75-PERCENTILE :5
95-PERCENTILE :5
X MIN. :1 1 1
X MAX. :5 5 5

Figure C-1 FREQUENCY HISTOGRAMS FOR NON-PARTICIPATION

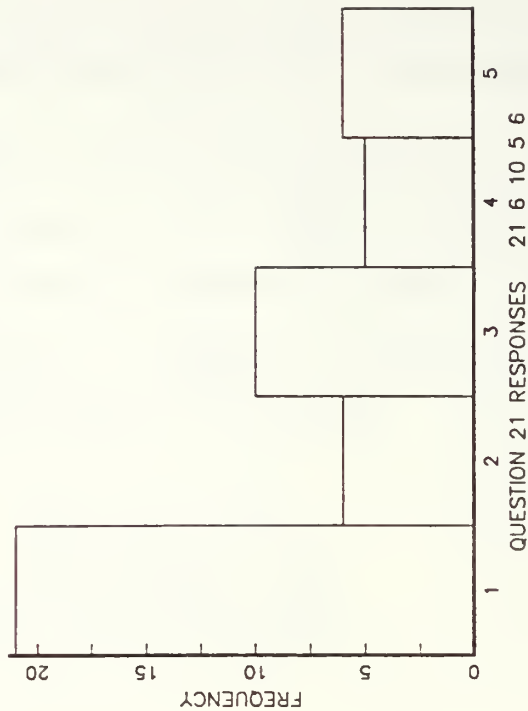
QUESTION 20: PRIME FLOW-DOWN REQMTS



HISTOGRAM TABLE

X SELECTION :Q20
X LABEL :ALL
X LABEL :QUESTION 20 RESPONSES 14 7 10 10 7
NO. OF CLEMENTS :48
X MEAN :2.7708
STD. DEVIATION :1.4475
SKEWNESS :0.10834
KURTOSIS :1.6622
5-PERCENTILE :1
25-PERCENTILE :1
MEDIAN :3
75-PERCENTILE :4
95-PERCENTILE :5
X MIN. :1 1 1
X MAX. :5 5 5

QUESTION 21: GOVERNMENT/PRIME ADVERSE RELATIONS

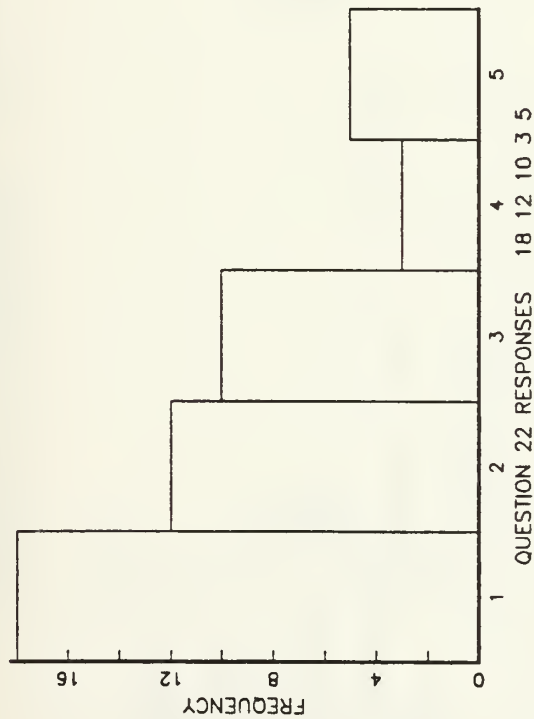


HISTOGRAM TABLE

X SELECTION :Q21
X LABEL :ALL
X LABEL :QUESTION 21 RESPONSES 21 6 10 5 6
NO. OF ELEMENTS :48
X MEAN :2.3542
STD. DEVIATION :1.4512
SKEWNESS :0.5889
KURTOSIS :1.9754
5-PERCENTILE :1
25-PERCENTILE :1
MEDIAN :2
75-PERCENTILE :3
95-PERCENTILE :5
X MIN. :1 1 1
X MAX. :5 5 5

Figure C-2 FREQUENCY HISTOGRAMS FOR NON-PARTICIPATION

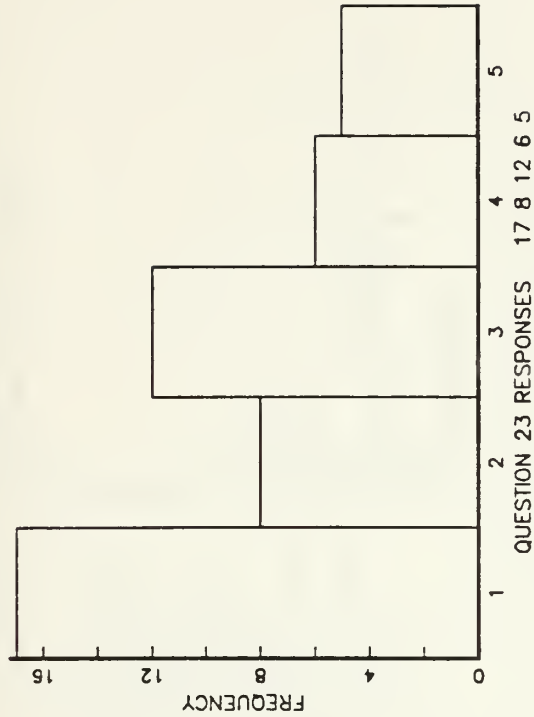
QUESTION 22: PRIME/SUB ADVERSE RELATIONS



HISTOGRAM TABLE

X	:Q22				
SELECTION	:ALL				
X LABEL	:QUESTION 22 RESPONSES	18	12	10	3 5
NO. OF ELEMENTS	:48				
X MEAN	:2.2708				
STD. DEVIATION	:1.3167				
SKEWNESS	:0.78982				
KURTOSIS	:2.5598				
5-PERCENTILE	:1				
25-PERCENTILE	:1				
MEDIAN	:2				
75-PERCENTILE	:3				
95-PERCENTILE	:5				
X MIN.	:1 1 1				
X MAX.	:5 5 5				

QUESTION 23: UNCERTAINTY OF GOVT BUSINESS BASE

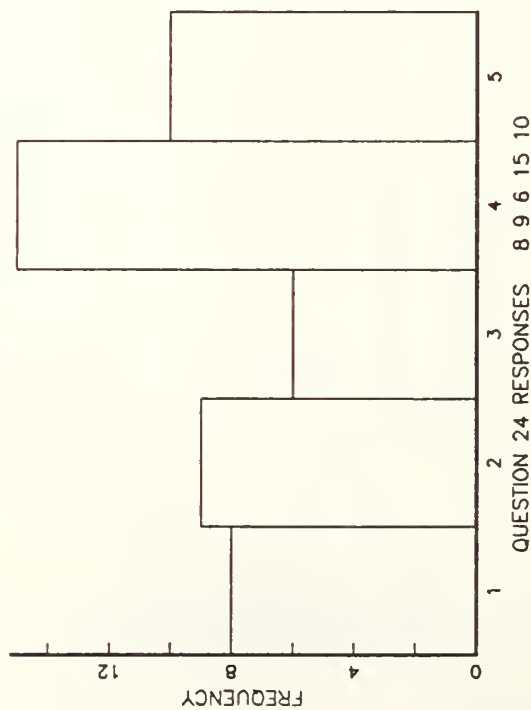


HISTOGRAM TABLE

X	:Q23				
SELECTION	:ALL				
X LABEL	:QUESTION 23 RESPONSES	17	8	12	6 5
NO. OF ELEMENTS	:48				
X MEAN	:2.4583				
STD. DEVIATION	:1.3677				
SKEWNESS	:0.44118				
KURTOSIS	:1.9924				
5-PERCENTILE	:1				
25-PERCENTILE	:1				
MEDIAN	:2				
75-PERCENTILE	:3				
95-PERCENTILE	:5				
X MIN.	:1 1 1				
X MAX.	:5 5 5				

Figure C-3 FREQUENCY HISTOGRAMS FOR NON-PARTICIPATION

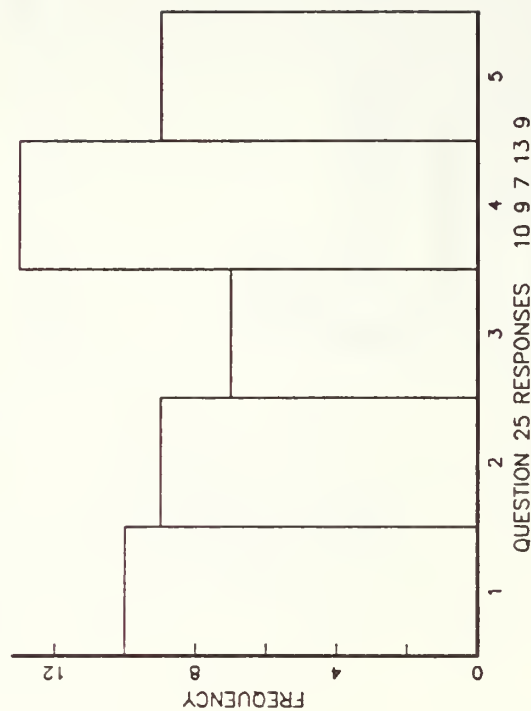
QUESTION 24: LOW PROFIT/LOST MONEY



HISTOGRAM TABLE

X :Q24
 SELECTION :ALL
 X LABEL :QUESTION 24 RESPONSES 8 9 6 15 10
 NO. OF ELEMENTS :48
 X MEAN :3.2083
 STD. DEVIATION :1.4136
 SKEWNESS :0.28265
 KURTOSIS :1.7327
 5-PERCENTILE :1
 25-PERCENTILE :2
 MEDIAN :4
 75-PERCENTILE :4
 95-PERCENTILE :5
 X MIN. :1 1 1
 X MAX. :5 5 5

QUESTION 25: HIGHER PRIME/SUB METHODS AND POLICIES

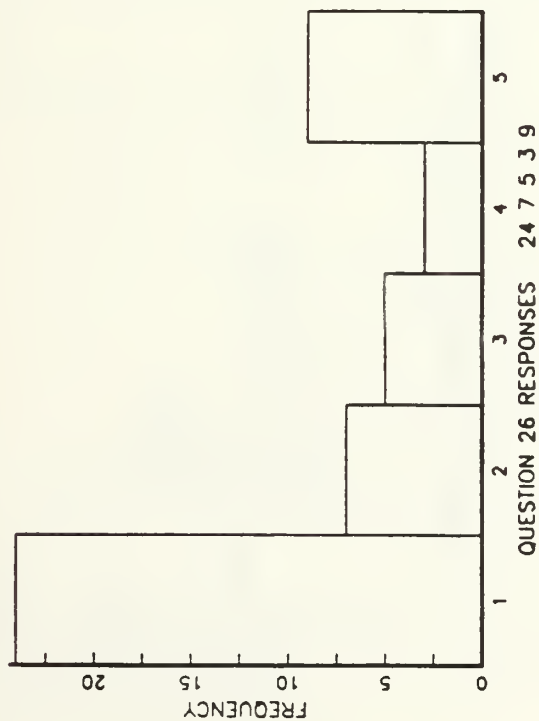


HISTOGRAM TABLE

X :Q25
 SELECTION :ALL
 X LABEL :QUESTION 25 RESPONSES 10 9 7 13 9
 NO. OF ELEMENTS :48
 X MEAN :3.0417
 STD. DEVIATION :1.4434
 SKEWNESS :0.11615
 KURTOSIS :1.6405
 5-PERCENTILE :1
 25-PERCENTILE :2
 MEDIAN :3
 75-PERCENTILE :4
 95-PERCENTILE :5
 X MIN. :1 1 1
 X MAX. :5 5 5

Figure C-4 FREQUENCY HISTOGRAMS FOR NON-PARTICIPATION

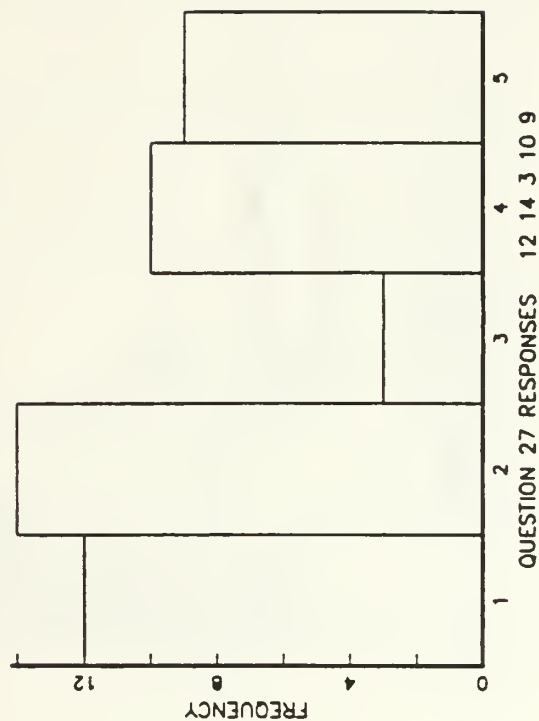
QUESTION 26: DO NOT KNOW HOW TO



HISTOGRAM TABLE

X	:Q26
SELECTION	:ALL
X LABEL	:QUESTION 26 RESPONSES
NO. OF ELEMENTS	:48
X MEAN	:2.2917
STD. DEVIATION	:1.5839
SKEWNESS	:0.77716
KURTOSIS	:1.995
5-PERCENTILE	:1
25-PERCENTILE	:1
MEDIAN	:1.5
75-PERCENTILE	:3.5
95-PERCENTILE	:5
X MIN.	:1 1 1
X MAX.	:5 5 5

QUESTION 27: GOVT/PRIME AUDITING REQMTS

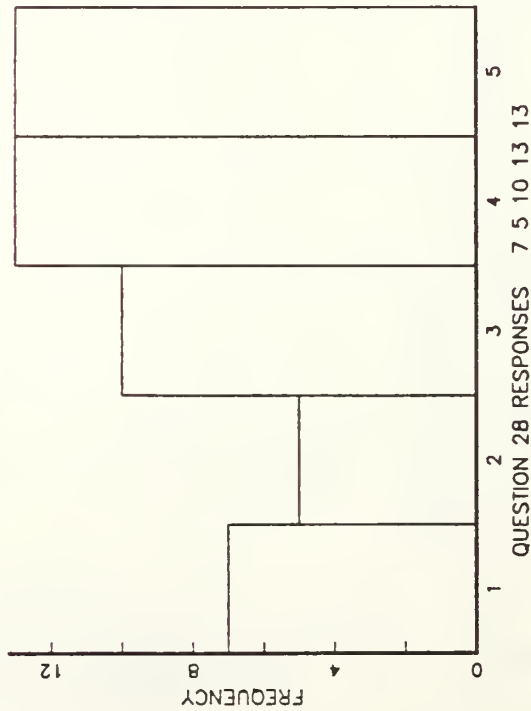


HISTOGRAM TABLE

X	:Q27
SELECTION	:ALL
X LABEL	:QUESTION 27 RESPONSES
NO. OF ELEMENTS	:48
X MEAN	:2.7917
STD. DEVIATION	:1.5012
SKEWNESS	:0.24554
KURTOSIS	:1.5597
5-PERCENTILE	:1
25-PERCENTILE	:1.5
MEDIAN	:2
75-PERCENTILE	:4
95-PERCENTILE	:5
X MIN.	:1 1 1
X MAX.	:5 5 5

Figure C-5 FREQUENCY HISTOGRAMS FOR NON-PARTICIPATION

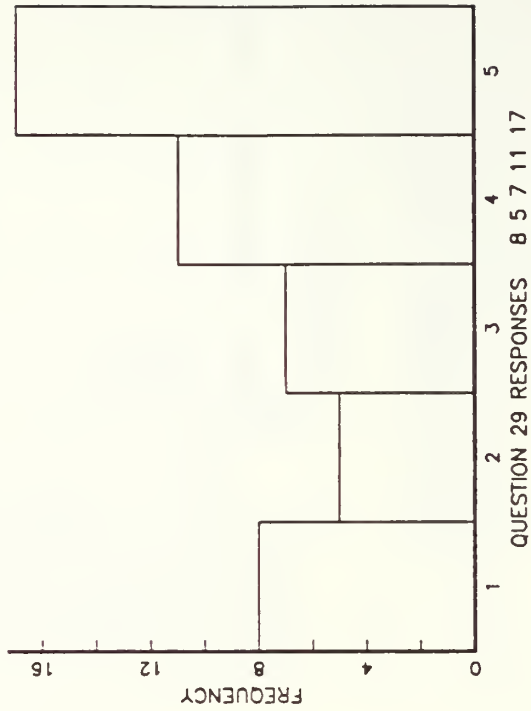
QUESTION 28: INCONSISTENT QUALITY REQMT'S



HISTOGRAM TABLE

X :Q28
 SELECTION :ALL
 X LABEL :QUESTION 28 RESPONSES 7 5 10 13 13
 NO. OF ELEMENTS :48
 X MEAN :3.4167
 STD. DEVIATION :1.3812
 SKEWNESS :-.048596
 KURTOSIS :2.0442
 5-PERCENTILE :1
 25-PERCENTILE :2.5
 MEDIAN :4
 75-PERCENTILE :5
 95-PERCENTILE :5
 X MIN. :1 1 1
 X MAX. :5 5 5

QUESTION 29: EXCESSIVE QUALITY STANDARDS

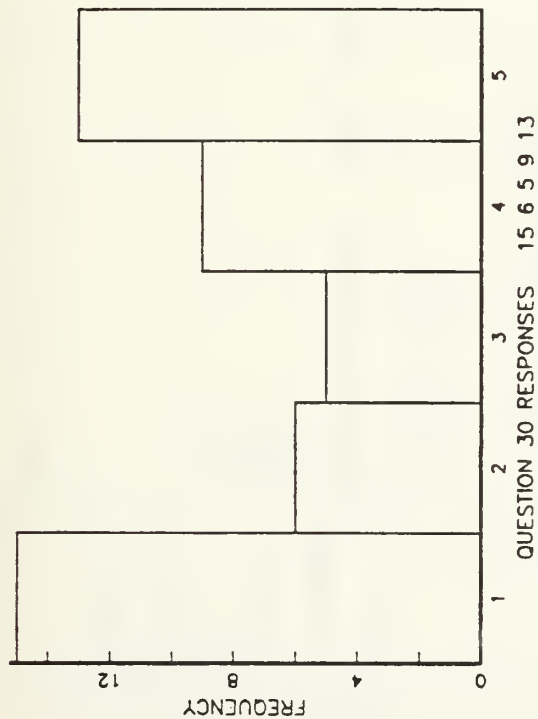


HISTOGRAM TABLE

X :Q29
 SELECTION :ALL
 X LABEL :QUESTION 29 RESPONSES 8 5 7 11 17
 NO. OF ELEMENTS :48
 X MEAN :3.5
 STD. DEVIATION :1.4875
 SKEWNESS :-.054872
 KURTOSIS :1.8861
 5-PERCENTILE :1
 25-PERCENTILE :2
 MEDIAN :4
 75-PERCENTILE :5
 95-PERCENTILE :5
 X MIN. :1 1 1
 X MAX. :5 5 5

Figure C-6 FREQUENCY HISTOGRAMS FOR NON-PARTICIPATION

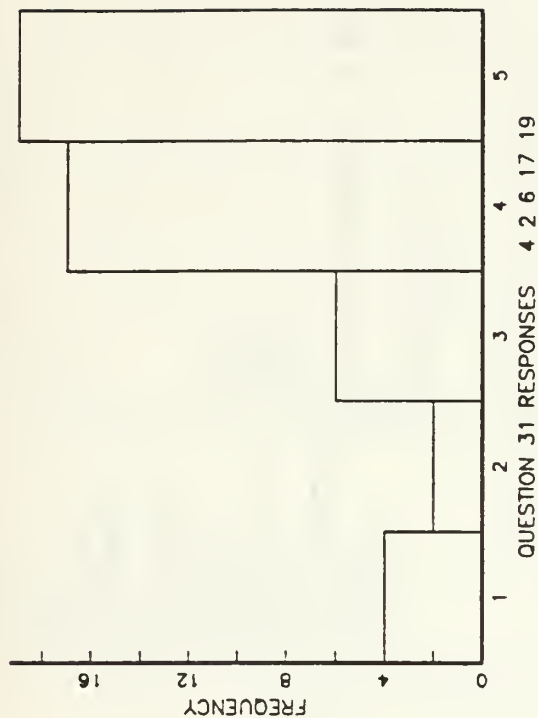
QUESTION 30: ACCEPTANCE/REJECTION PROBLEMS



HISTOGRAM TABLE

X	:Q30	
SELECTION	:ALL	
X LABEL	:QUESTION 30 RESPONSES	15 6 5 9 13
NO. OF ELEMENTS	:48	
X MEAN	:2.9792	
STD. DEVIATION	:1.6437	
SKEWNESS	:-0.024517	
KURTOSIS	:1.3761	
5-PERCENTILE	:1	
25-PERCENTILE	:1	
MEDIAN	:3	
75-PERCENTILE	:5	
95-PERCENTILE	:5	
X MIN.	:1 1 1	
X MAX.	:5 5 5	

QUESTION 31: INFLEXIBLE GOVT PROCUREMENT POLICIES

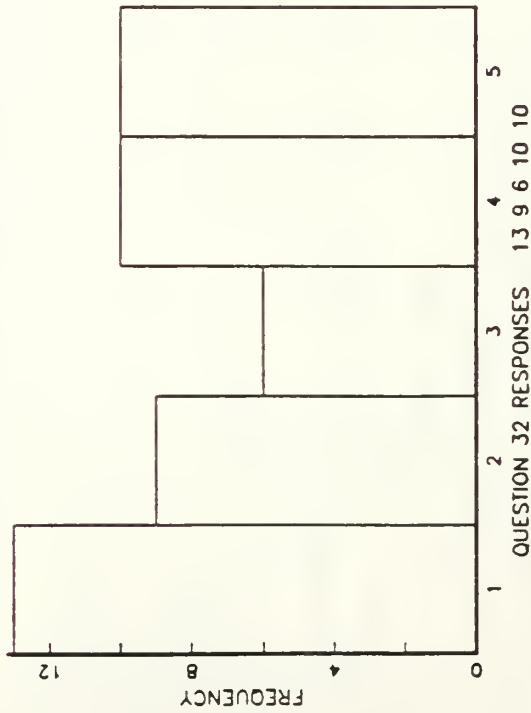


HISTOGRAM TABLE

X	:Q31	
SELECTION	:ALL	
X LABEL	:QUESTION 31 RESPONSES	4 2 6 17 19
NO. OF ELEMENTS	:48	
X MEAN	:3.9375	
STD. DEVIATION	:1.21	
SKEWNESS	:-1.1905	
KURTOSIS	:3.5972	
5-PERCENTILE	:1	
25-PERCENTILE	:3.5	
MEDIAN	:4	
75-PERCENTILE	:5	
95-PERCENTILE	:5	
X MIN.	:1 1 1	
X MAX.	:5 5 5	

Figure C-7 FREQUENCY HISTOGRAMS FOR NON-PARTICIPATION

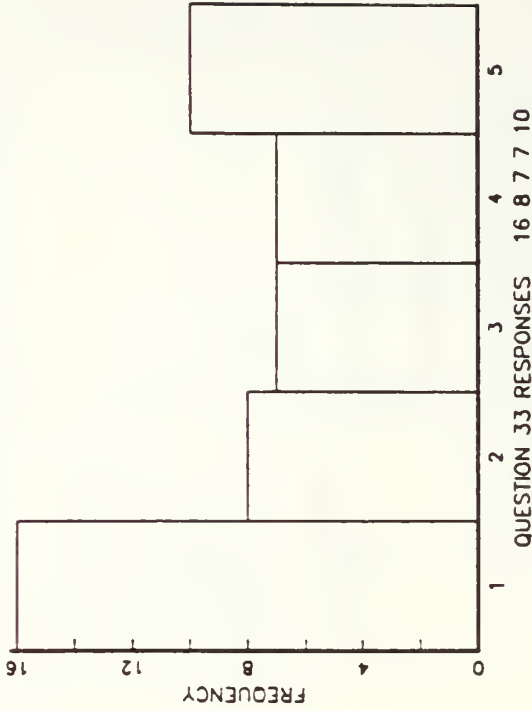
QUESTION 32: DELAYS AND FREQUENT CHANGES



HISTOGRAM TABLE

X	:Q32
SELECTION	:ALL
X LABEL	:QUESTION 32 RESPONSES
NO. OF ELEMENTS	:48
X MEAN	:2.8958
STD. DEVIATION	:1.5332
SKEWNESS	:0.069083
KURTOSIS	:1.5126
5-PERCENTILE	:1
25-PERCENTILE	:3
MEDIAN	:4
75-PERCENTILE	:5
95-PERCENTILE	:5
X MIN.	:1 1 1
X MAX.	:5 5 5

QUESTION 33: INEFFICIENT PRODUCTION LEVELS

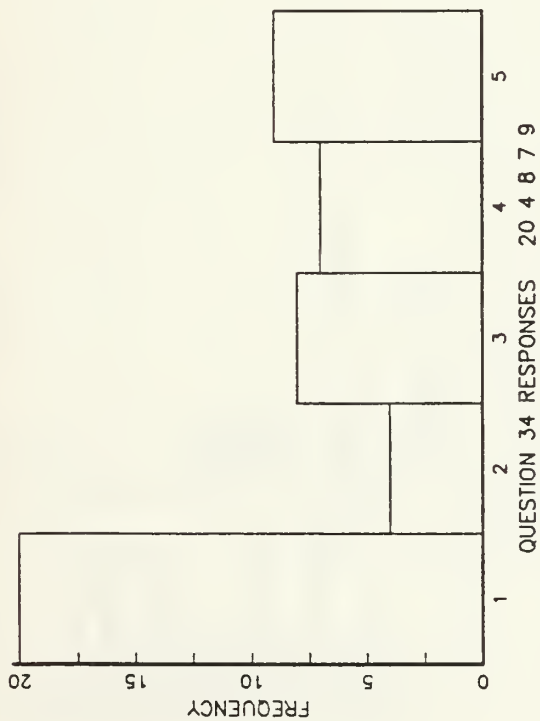


HISTOGRAM TABLE

X	:Q33
SELECTION	:ALL
X LABEL	:QUESTION 33 RESPONSES
NO. OF ELEMENTS	:48
X MEAN	:2.7292
STD. DEVIATION	:1.5675
SKEWNESS	:0.25559
KURTOSIS	:1.546
5-PERCENTILE	:1
25-PERCENTILE	:1
MEDIAN	:2.5
75-PERCENTILE	:4
95-PERCENTILE	:5
X MIN.	:1 1 1
X MAX.	:5 5 5

Figure C-8 FREQUENCY HISTOGRAMS FOR NON-PARTICIPATION

QUESTION 34: HORROR STORIES

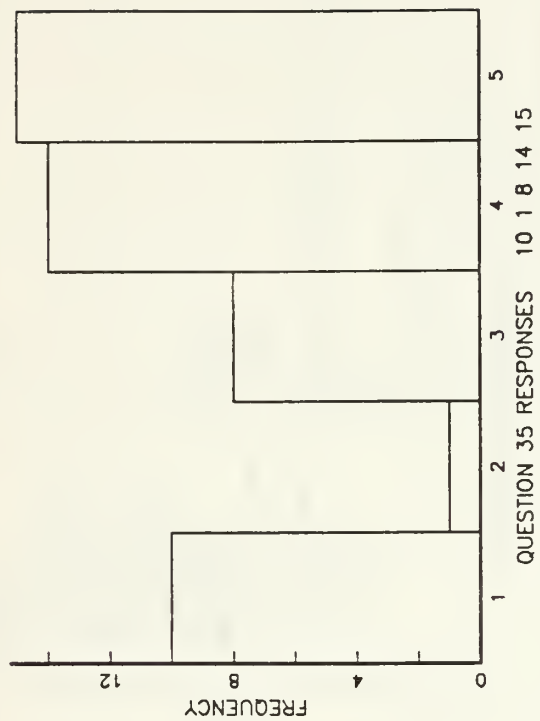


HISTOGRAM TABLE

```

X      SELECTION      :Q34
X LABEL :ALL
NO. OF ELEMENTS :48
X MEAN   :2.6042
STD. DEVIATION :1.5944
SKEWNESS :0.31755
KURTOSIS  :1.5342
5-PERCENTILE :1
25-PERCENTILE :1
MEDIAN       :2.5
75-PERCENTILE :4
95-PERCENTILE :5
X MIN.       :1 1 1
X MAX.       :5 5 5
  
```

QUESTION 35: MORE ATTRACTIVE COMMERCIAL SALES



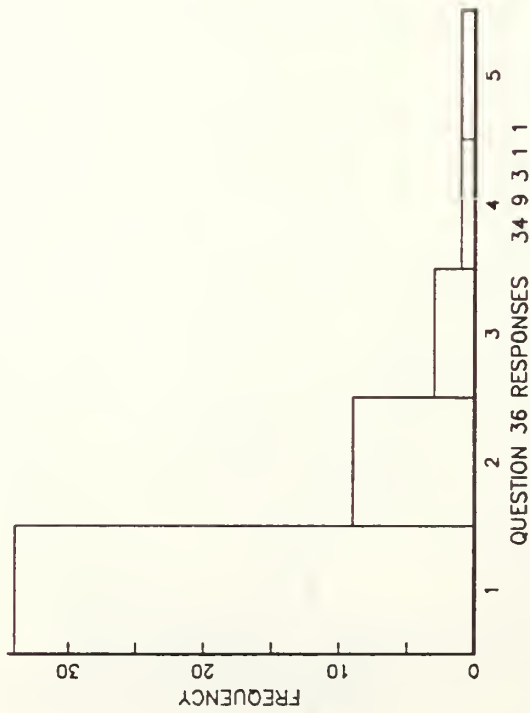
HISTOGRAM TABLE

```

X      SELECTION      :Q35
X LABEL :ALL
NO. OF ELEMENTS :48
X MEAN   :3.4792
STD. DEVIATION :1.4874
SKEWNESS :-0.66487
KURTOSIS  :2.0611
5-PERCENTILE :1
25-PERCENTILE :3
MEDIAN       :4
75-PERCENTILE :5
95-PERCENTILE :5
X MIN.       :1 1 1
X MAX.       :5 5 5
  
```

Figure C-9 FREQUENCY HISTOGRAMS FOR NON-PARTICIPATION

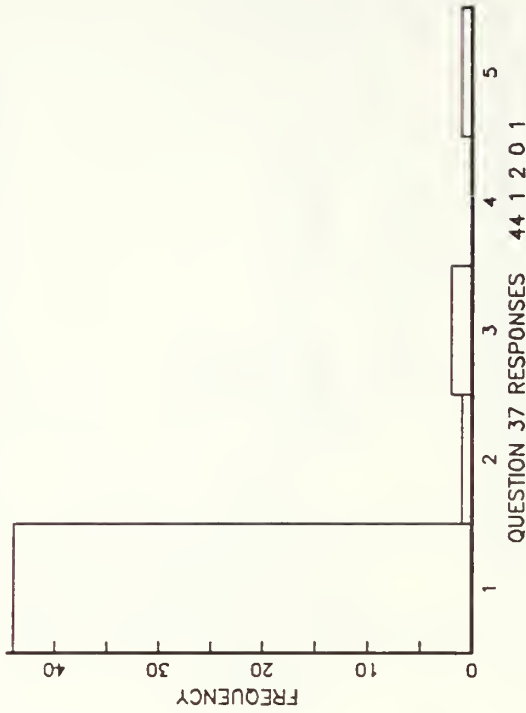
QUESTION 36: LACK PRODUCTION CAPABILITY/CAPACITY



HISTOGRAM TABLE

X :Q36
 SELECTION :ALL
 X LABEL :QUESTION 36 RESPONSES 34 9 3 1 1
 NO. OF ELEMENTS :48
 X MEAN :1.4583
 STD. DEVIATION :0.87418
 SKEWNESS :2.2528
 KURTOSIS :8.1224
 5-PERCENTILE :1
 25-PERCENTILE :1
 MEDIAN :1
 75-PERCENTILE :2
 95-PERCENTILE :3.1
 X MIN. :1 1 1
 X MAX. :5 4 3

QUESTION 37: FOREIGN SOURCES OF SUPPLY

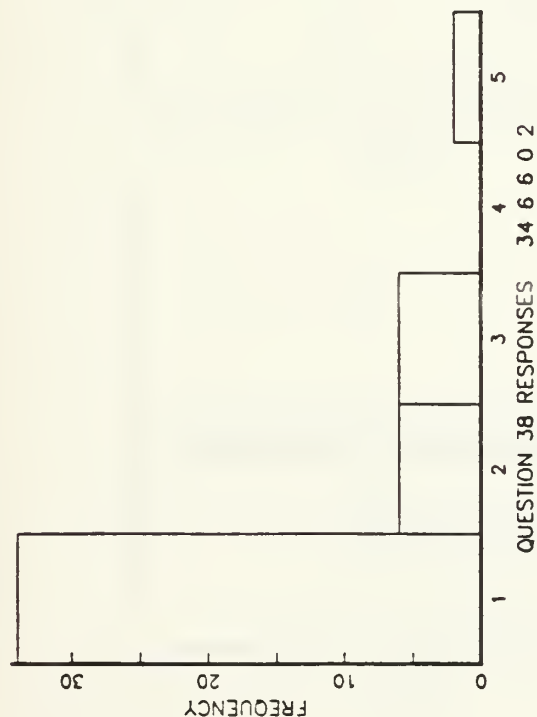


HISTOGRAM TABLE

X :Q37
 SELECTION :ALL
 X LABEL :QUESTION 37 RESPONSES 44 1 2 0 1
 NO. OF ELEMENTS :48
 X MEAN :1.1875
 STD. DEVIATION :0.70428
 SKEWNESS :4.159
 KURTOSIS :20.609
 5-PERCENTILE :1
 25-PERCENTILE :1
 MEDIAN :1
 75-PERCENTILE :1
 95-PERCENTILE :3
 X MIN. :1 1 1
 X MAX. :5 3 3

Figure C-10 FREQUENCY HISTOGRAMS FOR NON-PARTICIPATION

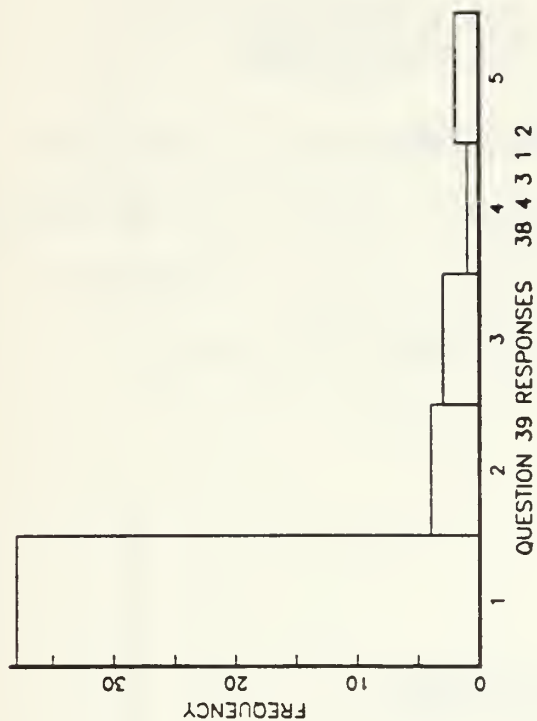
QUESTION 38: LOST DOD CONTRACTS TO COMPETITION



HISTOGRAM TABLE

X	:Q38
SELECTION	:ALL
X LABEL	:QUESTION 38 RESPONSES
NO. OF ELEMENTS	:48
X MEAN	:1.5417
STD. DEVIATION	:1.0097
SKEWNESS	:2.0158
KURTOSIS	:6.615
5-PERCENTILE	:1
25-PERCENTILE	:1
MEDIAN	:1
75-PERCENTILE	:2
95-PERCENTILE	:3.2
X MIN.	:1 1 1
X MAX.	:5 5 3

QUESTION 39: PREVIOUS CONTRACTS TERMINATED



HISTOGRAM TABLE

X	:Q39
SELECTION	:ALL
X LABEL	:QUESTION 39 RESPONSES
NO. OF ELEMENTS	:48
X MEAN	:1.4375
STD. DEVIATION	:1.0086
SKEWNESS	:2.4356
KURTOSIS	:8.0825
5-PERCENTILE	:1
25-PERCENTILE	:1
MEDIAN	:1
75-PERCENTILE	:1
95-PERCENTILE	:4.1
X MIN.	:1 1 1
X MAX.	:5 5 4

Figure C-11 FREQUENCY HISTOGRAMS FOR NON-PARTICIPATION

APPENDIX D

HYPOTHESIS TESTS FOR DIFFERENCES IN GET OUT/STAY OUT CONTRACTORS

The following figures graphically illustrate the differences between GET OUT and STAY OUT subcontractor responses to survey questions 4, 5, 6, 9, 10 and 12. This graphical data is analyzed in Chapter IV.

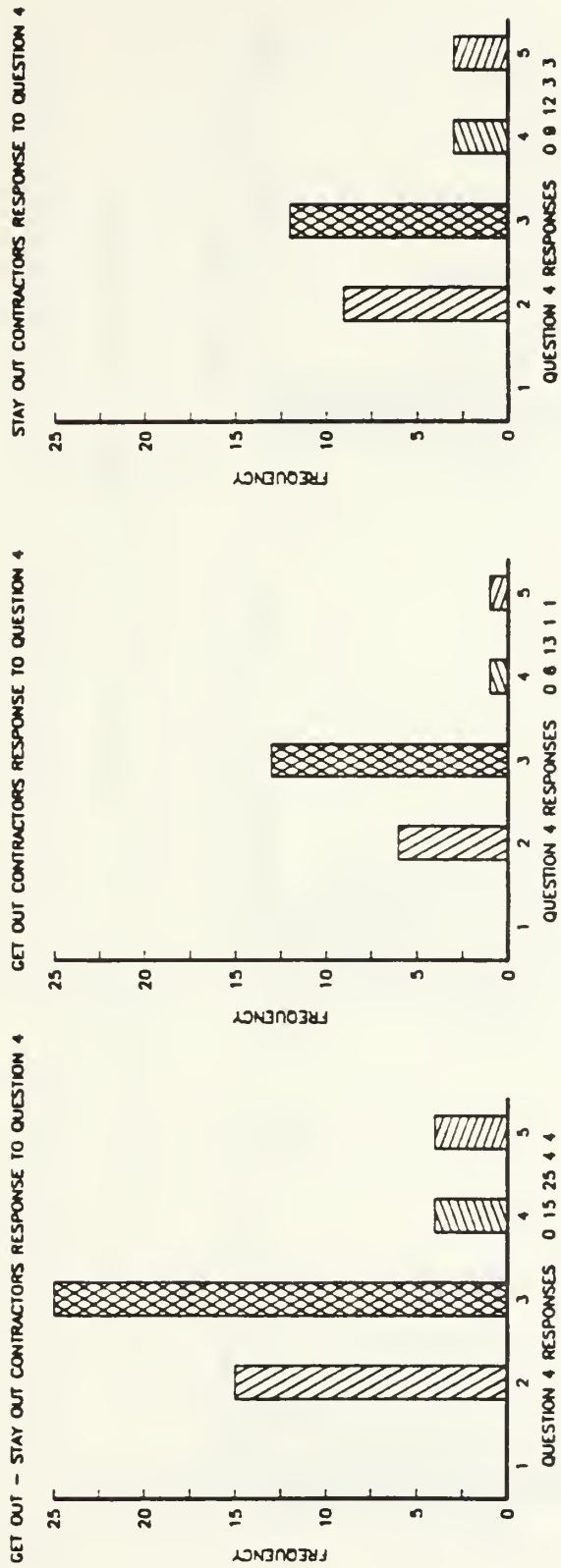


Figure D-1 GET OUT/STAY OUT ANALYSIS OF QUESTION 4 RESPONSES

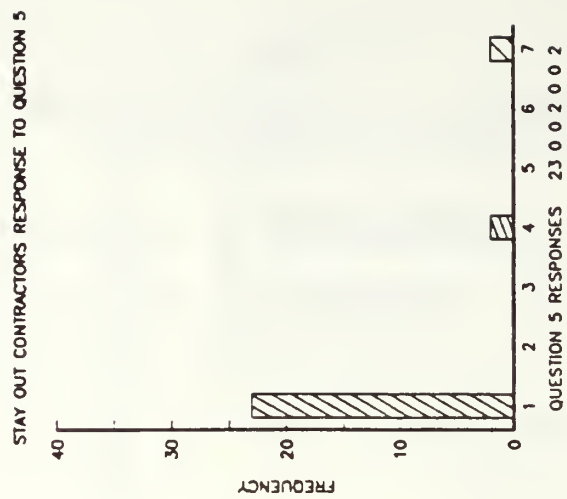
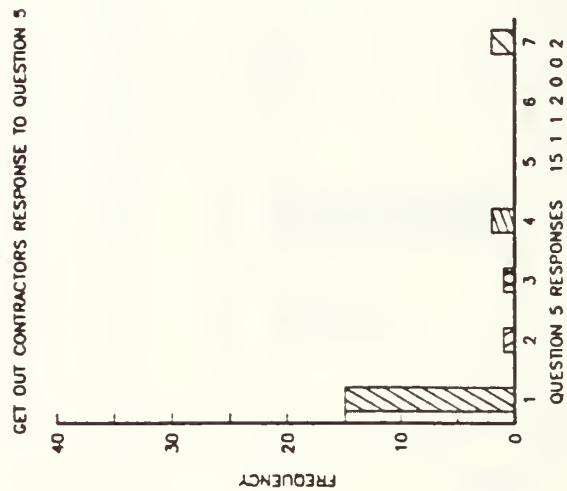
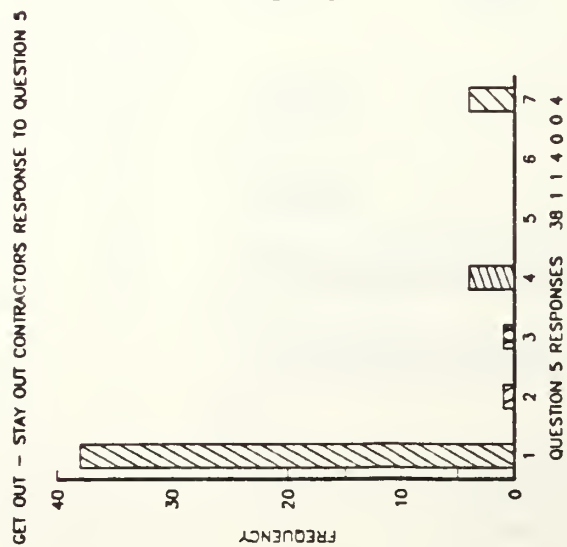


Figure D-2 GET OUT/STAY OUT ANALYSIS OF QUESTION 5 RESPONSES

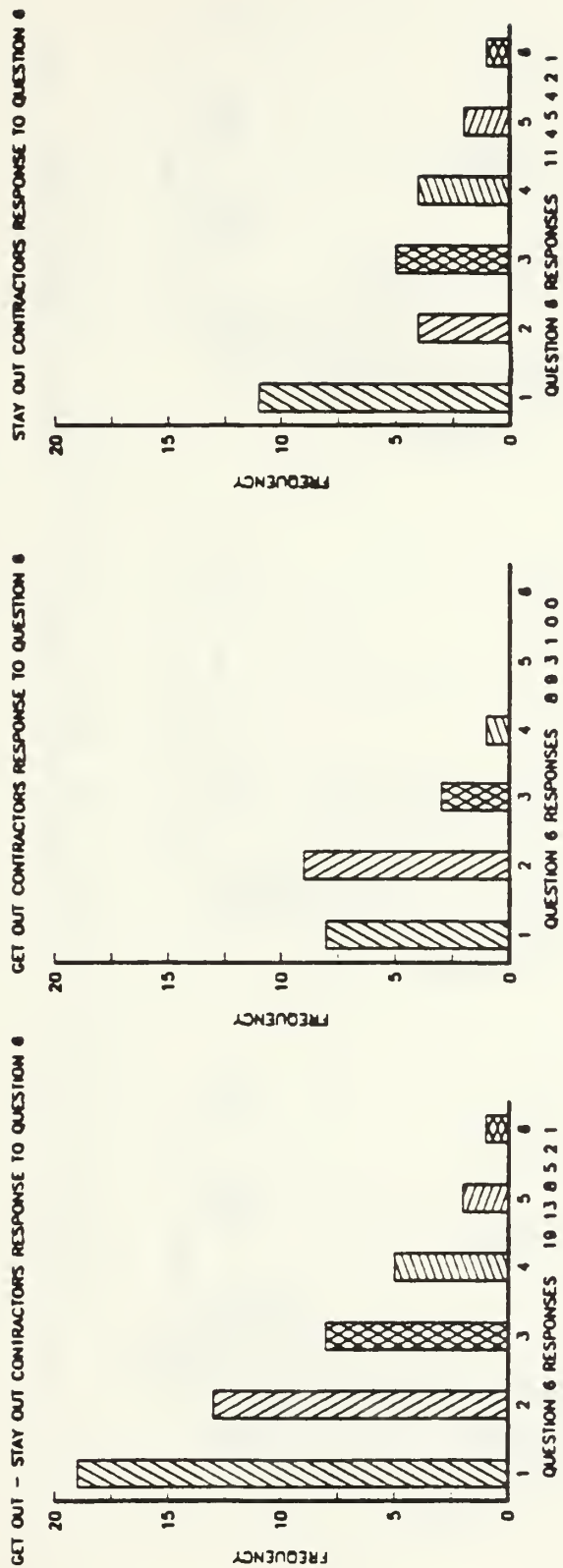


Figure D-3 GET OUT/STAY OUT ANALYSIS OF QUESTION 6 RESPONSES

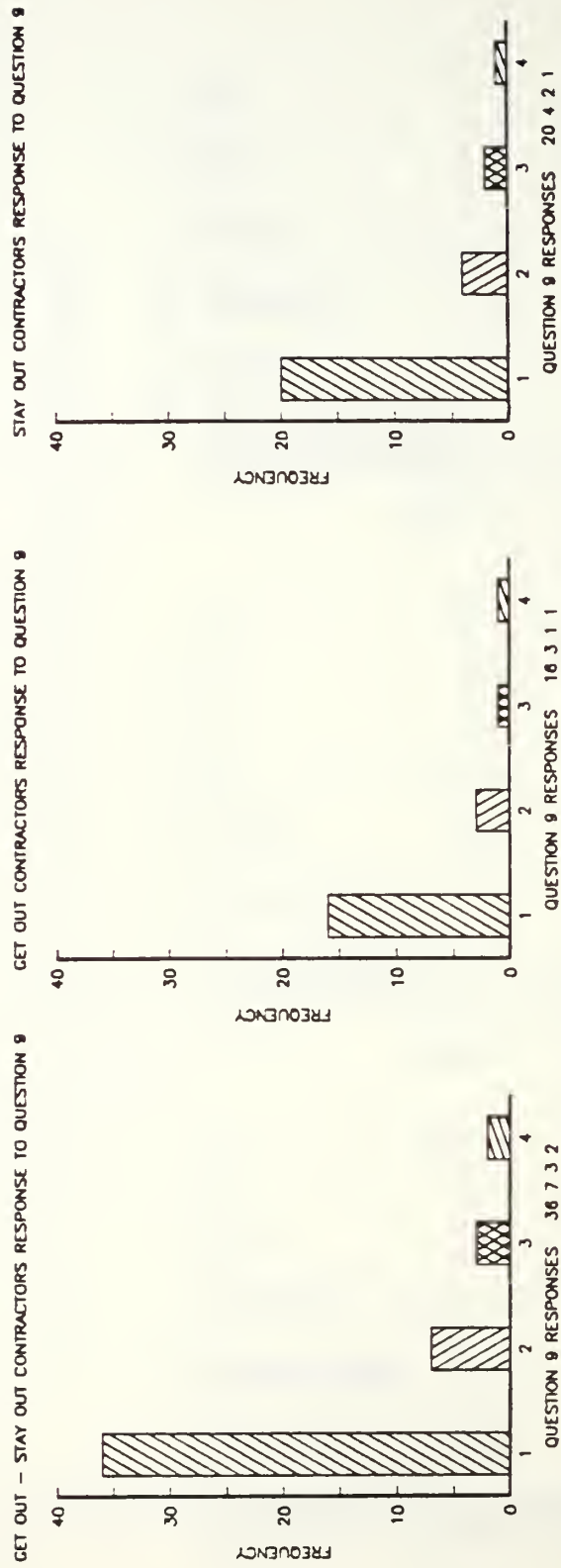


Figure D-4 GET OUT/STAY OUT ANALYSIS OF QUESTION 9 RESPONSES

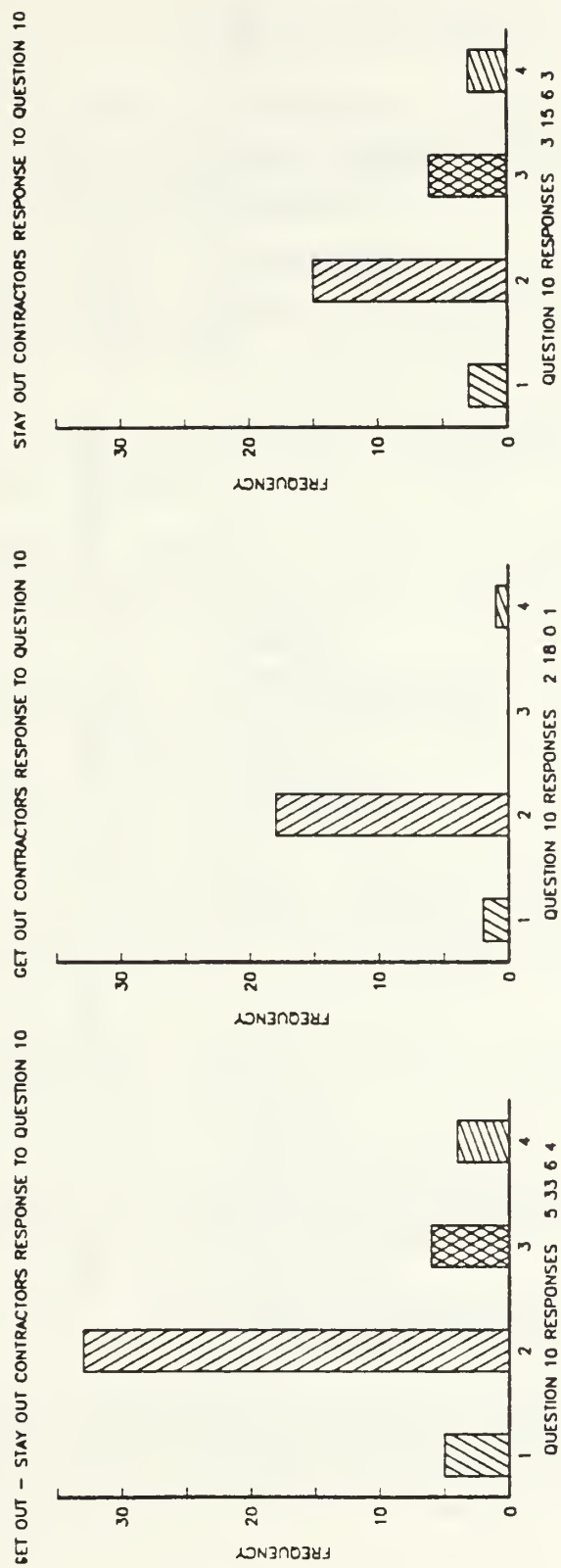


Figure D-5 GET OUT/STAY OUT ANALYSIS OF QUESTION 10 RESPONSES

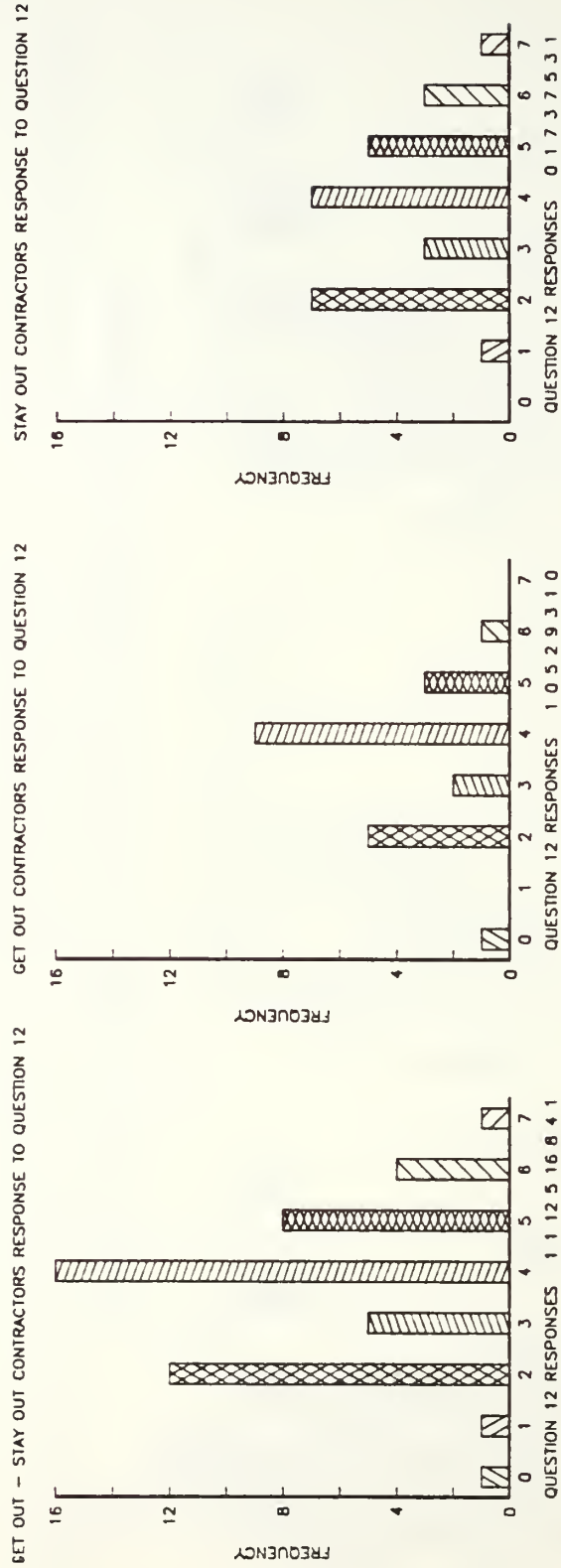


Figure D-6 GET OUT/STAY OUT ANALYSIS OF QUESTION 12 RESPONSES

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